ETC ECOLOGICAL
Eco-Tech Consultants, Inc.

September 8, 2008

Pam Loeffler
Attn: CELRL-OP-FS
U.S. Army Engineer District, Louisville
Corps of Engineers
P.O. Box 59
Louisville, KY 40201-0059

Joyce Fry
Water Quality Certification
Kentucky Division of Water
14 Reilly Road
Frankfort, KY 40601

RE: Jim Beam Old Crow Warehouse Facility, Glenn's Creek
USACE # LRL-2007-01461-pjl
KDOW # AI 40205

Ms. Loeffler and Ms. Fry:

As agent for Beam Global Spirits and Wines, Inc., Eco-Tech Consultants, Inc. hereby submits the enclosed Department of the Army and Water Quality Certification after-the-fact permit applications for unauthorized stream impacts at the Jim Beam Old Crow Warehouse Facility, Woodford County, Kentucky. The un-permitted activity involved sediment and debris clearing throughout a1,200 linear foot reach of Glenn's Creek, a perennial tributary of the Kentucky River.

A compensatory mitigation plan is included in the supporting documents and consists of 1,800 linear feet of stream and riparian restoration within and adjacent to the impact reach. Additionally, the protection of a high quality, 1,800 linear foot reach of lower Glenn's Creek in the form of a deed restriction is proposed.

Beam Global is wholly committed to compliance in this matter under the framework of the Clean Water Act. Please contact me directly to discuss any of the items contained herein.

Sincerely,

Peter 'Lee' Droppelman
President/Principal Scientist

Enclosure

Cc: James Trusley, Beam Global Spirits and Wines, Inc.
Rick Price. Beam Global Spirits and Wines, Inc.
Pat Stallard, Stites and Harbison PLLC

931 E. Main St. Frankfort, KY 40601 | 502.695.8060 office | 502.695.8061 fax | www.ecotechinc.com

AFTER-THE-FACT APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT & WATER QUALITY CERTIFICATION

UNAUTHORIZED STREAM ACTIVITIES PERFORMED AT THE JIM BEAM OLD CROW WAREHOUSE FACILITY WOODFORD COUNTY, KY

KDOW AI NO. 40205
USACE PROJECT # LRL-2007-01461-PJL

Submitted to:

United States Army Corps of Engineers, Louisville District
&
Energy and Environmental Cabinet, Kentucky Division of Water

Applicant:

Beam Global Spirits and Wines, Inc.
(Agent: Eco-Tech Consultants, Inc)

September 2008

ETC
Eco-Tech Consultants, Inc.

ETC ECOLOGICAL
Eco-Tech Consultants, Inc.

Supporting Documentation for
Jim Beam Old Crow Warehouse Facility
After-the-Fact 404/401 Permitting
September 8, 2008

Table of Contents

List of Attachments

Attachment 1 - 404/401 Permit Applications
1. Individual Department of Army Permit Application
2. KDOW Water Quality Certification Application

Attachment 2 - Exhibits
1. Project Vicinity Topographic Map
2. Project Site Aerial Map
3. Impact Area Map
4. Riparian Vegetation Enhancement Map
5. Proposed Protection Reach Topographic Map
6. Proposed Protection Reach Aerial Map

Attachment 3 - Glenns Creek Watershed and Stream Assessment Report
Completed by Stantec Consulting Services (2008)

Attachment 4 - Conceptual Stream Restoration Plan Figures
Completed by Stantec Consulting Services (2008)
1. Conceptual Plan
2. Profile
3. Details - Cross Vane
4. Details - Cross Vane with Step
5. Details - J-Hook Vane
6. Details - Step Pool
7. Details - Typical Section (Priority II)
8. Details - Stone Toe & Live Staking
9. Details - Pump-Around

Attachment 5 - Glenn's Creek Geomorphic Assessment
Completed by Eco-Tech Consultants, Inc. (2008)

Attachment 6 - Photographs

Attachment 7 - Habitat Data Forms
1. Impact Reach
2. Preservation Reach

Attachment 8 - Draft Deed Restriction

Attachment 9 - U.S. Fish and Wildlife Service Early Coordination Letter

Attachment 10 - List of Adjacent Property Owners

1. Introduction

1.1. Description of the Activity

As agent for Jim Beam Spirits and Wines, Inc. (JBSW), Eco-Tech Consultants, Inc. (ETC) hereby submits U.S. Army Corps of Engineers (USACE) Department of the Army (DOA) Permit and Kentucky Division of Water (KDOW) Water Quality Certification (WQC) after-the-fact applications (Attachment 1) for un-permitted activities completed at the Jim Beam Old Crow Warehouse Facility, Woodford County, Kentucky.

The Old Crow Warehouse Facility is located approximately 3.5 miles southeast of Frankfort, Kentucky adjacent to Glenn's Creek Road along the Woodford/Franklin County line (Attachment 2, Figures 1 and 2). Today, the location is primarily used as warehouse storage for the long-term aging of distilled beverages, however there is a history of extensive distilling activity throughout the Glenn's Creek valley. The impacted stream, Glenn's Creek, runs through and adjacent to the site. It is a perennial, direct tributary of the Kentucky River with a drainage area of 33 square miles. The US Geological Survey (USGS) hydrological unit code (HUC) is 05100205240.

The completed activities prompting regulatory action included the removal of approximately 2,500 cubic yards of accumulated fine/coarse sediment and large woody debris to the underlying bedrock within the ordinary high water boundaries of Glenn's Creek for approximately 1,200 linear feet (Attachment 2 - Figure 3). Mechanically moved material was spread along the stream banks and stockpiled within the floodplain. Additionally, just upstream of the facility access bridge, loose material and two to three feet of bedrock was removed in an attempt to alleviate flood concerns caused by the undersized bridge cross section.

In April of 2008 the watershed experienced a significant rainfall event, causing a re-deposition of much of the removed stream bed substrate placed along the banks. In response, JBSW proceeded with a concerted effort to study, model, and correct stability problems in place prior to the unpermitted substrate removal and exacerbated following the activity. Included in these supporting documents are an initial geomorphic assessment performed prior to the flood event completed by ETC (Attachment 5) and a subsequent, more detailed study of hydrology/hydraulics of the watershed (Attachment 3) completed by Stantec Consulting Services (Stantec) in preparation for design of compensatory mitigation plan.

1.2. Identification of Responsible Parties

Applicant:

Rick Price, Environmental, Health & Safety Director
Beam Global Spirits and Wines, Inc.
P O Box 426
Georgetown Road
Frankfort, KY 40601
(502) 695-3010

Agent:

Lee Droppelman, Principal Scientist
Eco-Tech Consultants, Inc.
931 East Main Street
Frankfort, KY 40601
(502) 695-8060

1.3. After-the-fact Regulatory Compliance

This application and supporting documents is submitted in fulfillment of regulatory requirements as conveyed during verbal communication, pre-application meetings, and formal notifications issued by each controlling agency. More particularly, this application package satisfies the terms set forth under the "Tolling Agreement" and accompanying letter from the USACE sent February 19, 2008, and KDOW's "Request for Additional Information" and "Application Withdrawn" letters transmitted on November 19, and December 17, 2007, respectively.

2. Site Characterization

Glenn's Creek drains 33 square miles in Woodford and Franklin Counties, with a watershed extending from its headwaters near the City of Versailles, north to the Kentucky River. Land uses include forest, row-crop agriculture, pasture, urban and suburban development, commercial development and industrial development. Several distilleries, both active and inactive, are located along the creek. The mouth of the creek is approximately 1 mile downstream of the project site. The watershed consists primarily of rugged, steep terrain with a narrow floodplain.

Glenn's Creek has been highly modified throughout its length, with significant occurrences of impoundments, low-water crossings, utility crossings, bridges, culverts, retaining walls, and floodplain development. Much of the stream channel has been scoured to bed rock, resulting in significant bed load contributions of fractured limestone cobble and boulder sized sediment particles. Deposition of the elevated bed load is commonly observed upstream of structures that reduce the cross-sectional area needed to pass a stream flow with sufficient energy to transport cobble and boulder particle sizes. Such is the case at the Old Crow Warehouse Facility, where a concrete slab bridge is present to allow vehicular access to warehouses located on both the north and south floodplains. At this restriction point, the operations staff of the facility have repeatedly had to repair and recoup losses to assets from the frequent flooding and physical damage to infrastructure.

Within the boundaries of the Old Crow Warehouse Facility, Glenn's Creek has an estimated discharge of 13,300 cfs, as calculated upon review of USGS gauging stations in the area. The average watercourse bedslope for Glenns Creek is 0.50%. Glenn's Creek is an F3/1 Rosgen stream type through the project reach, meaning it is characterized is having a bedrock/cobble substrate, high width/depth ratio, high entrenchment, and moderate sinuosity. It is a consistent stream condition where extensive lateral migration of the stream channel has resulted after vertical cutting to bedrock strata. While the top of the bank is irregular, it is consistently above bankfull elevations in the profile.

The stream valley is a Type II and is characterized as colluvial. The presence of bedrock in the valley and steep hillsides are also characteristic of fault controlled or Type VI valleys. B-type streams are common in both valley types. F and C channels are also found in Type VI valleys. Anthropogenic activities such as dam construction and fill placement appear to have reduced gradients in the valley. Fill placement and existing buildings prevent the development of a wide floodprone area that is typical of C type streams. Considering these observations along with the existing bankfull and valley slopes, and bedrock control the potential stream type through project reach is B3/1c.

KDOW habitat assessment forms were completed within the impacted reach. Because investigations were performed post-activity, they do not represent the reference habitat condition within Glenn's Creek at the Old Crow site. The habitat assessment procedure is focused towards ten parameters determined to influence the overall ability of the stream's physical attributes to foster diverse aquatic biological assemblages. Parameters such as riparian vegetation quality, bank stability, diversity of habitat, and substrate characteristics are generally represented. Within the 1,200-foot impact reach, scores were obtained at three separate locations below the threshold for the full support of aquatic uses (AS-3, 4, and 5 in Attachment 7). The average habitat value was 89 out of 200. This low value is the result of highly mobile depositional bars, recent dredging to bedrock, instability along the stream bank, and lack of a wide riparian corridor.

Additional information regarding the existing condition of Glenn's Creek can be found in the attached geomorphic assessment documents, photographic vouchers, and KDOW habitat forms (Attachments 3, 5, 6, and 7).

3. Threatened/Endangered Species and Critical Habitat

Formal request for federally listed species occurrence was initiated with the U.S. Fish and Wildlife, Kentucky Field Office on July 25, 2008. Written response was received on July 28, 2008 (Attachment 9). In this communication, the following species where listed as having the potential to occur on the Old Crow property:

Table 1. Federally Listed Species reported by USFWS as having the potential to occur in the project area.

Species	Common Name	Status	Habitat Present
Mammal			
Myotis sodalis	Indiana bat	E	Marginal
Myotis grisescens	Gray bat	E	Foraging
Plant			
Trifolium stoloniferum	Running buffalo clover	E	Yes
Arabis perstellata	Braun's rock cress	E	No
Lesquerella globosa	Globe bladderpod	C	No

3.1. Indiana bat

In the summer, Indiana bats utilize a wide array of forested habitats, including riparian forests, bottomlands, and uplands for both foraging and roosting habitat. Indiana bats typically roost under exfoliating bark, in cavities of dead and live trees, and in snags. Trees in excess of 16 inches in diameter are considered optimal for maternity colony roosts, but roosts have been documented in trees as small as 3 inches diameter. In winter, Indiana bats congregate in caves and abandoned mines to hibernate.

Within the boundaries of the project, there is marginal roosting habitat. However, individual trees are present that are of sufficient size and condition that they may foster Indiana bat roosting individuals or colonies. As part of restoration activities within the Old Crow Warehouse Facility, very few trees will be removed – only when stream bank stabilization warrants re-grading. Those that do require removal will be cleared during the allowable period between

October 15 and March 31, as conditioned in the Early Coordination Letter received from U.S. Fish and Wildlife Service. If potential roost trees cannot be removed during this period then further guidance will be sought by USFWS. Activities such as emergence counts and or direct surveys may be performed.

No caves or abandoned mines are located within or adjacent to the Old Crow site, therefore no hibernaculum surveys are proposed.

3.2. Gray bat

Gray bats roost, breed, rear young, and hibernate in caves year round. They migrate between summer and winter caves and will use transient or stopover caves along the way. Gray bats forage along medium sized creeks and rivers to large lakes up to 12 miles from their roost locations.

Within the Old Crow property boundaries there are no caves or underground mines. Stream foraging may have been affected temporarily with the removal and redistribution of instream habitat necessary for the development of insect prey items. However, stream restoration activities are proposed herein, and are expected to increase the quality of available habitat for invertebrates and other fauna.

3.3. Running buffalo clover

Running buffalo clover habitat consists of old trails, traces, and roads; grazed bottomlands, stream banks, lawns, shoals, and cemeteries with native vegetation, prairies, well-drained and mesic soils, and filtered to partial light. Flowering period is early April to mid-summer. Several locations of this plant are known from Woodford County.

Potential habitat for running buffalo clover does exist along the riparian margins of the impact reach. At the conclusion of the flowering period in 2008 the riparian area had been recently mowed and a presence/absence survey was not feasible. Therefore, a presence/ absence determination within the boundaries of the proposed action will be completed during the next appropriate season.

3.4. Braun's rockcress

Habitat consists of rocky, wooded slopes on blackish clay loams over limestone or acid limestone cobble. Flowering period is early April to late May. Braun's rockcress produces white to lavender cross-shaped flowers in late March-early May. The fruits are long pods, containing reddish- brown, flattened seeds about 1mm long.

Within the overall boundaries of the Jim Beam property, there does exist potential habitat for Braun's rockcress along steep ridge slopes. However, this habitat does not fall within the work area of the proposed activity. Restoration tasks will be isolated to the stream channel and immediate floodplain. Therefore, the proposed action is not likely to adversely affect the continued existence of the species.

3.5. Globe bladderpod

Habitat consists of calcareous rocks and barrens, wooded cliff edges. Flowers are bright yellow to yellow-orange, cross-shaped, each having 4 petals about 5 mm long. Fruit is a nearly globe-shaped capsule, about 3 mm in diameter, with 1 or 2 seeds in each cell.

For the same reasons as previously listed for Braun's rockcress, the proposed action is not likely to adversely affect the continued existence of the species.

4. Historic and Cultural Resources

The National Register Information System (http://www.nr.nps.gov/) was consulted for current listings of historic places in the vicinity of the Old Crow warehouse site (Woodford and Franklin counties). No current properties were identified within the boundaries of the completed or proposed activities. Properties eligible for listing or potentially eligible for listing are not known. An assessment of archaeological resources has not been completed.

5. Compensatory Mitigation Plan

This indicates that the reach is incised and a Priority II restoration is needed through the reach. A Priority II restoration reconnects the bankfull channel to a floodplain at a lower level than the original floodplain. Identifying the valley type is an important consideration in determining a stream's potential.

5.1. Objectives

The goals of the mitigation plan are:

- To improve aquatic habitat by:
  - Re-establishing riffle pool complex along the reach;
  - Restoring cobble substrate;
  - Shading the stream to reduce water temperature and raise dissolved oxygen levels;
  - Using structures that both protect stream banks, improve water quality, provide refuge for fish and allow fish passage; and
  - Providing a source of organic matter for the proliferation of aquatic organisms in the stream.

- To improve riparian habitat by planting native tree(s), understory and ground cover that:
  - Provides food and shelter for wildlife; and
  - Supports a diverse and self-sustaining wildlife community.

5.2. Site Selection

The conceptual plan for the mitigation of the impacted reach is presented in the plans provided in Attachment 4. The plan includes stream restoration and enhancement along an 1,800 linear foot (LF) section of stream on the Old Crow Warehouse Facility property: approximately 1,400

LF in the vicinity of the reach impacted by maintenance activities and approximately 400 LF at the downstream abandoned railroad bridge.

Glenns Creek was divided into two restoration reaches within the boundaries of the Old Crow Warehouse Facility property. These reaches were selected because they have the greatest potential of providing a total of 1,800 linear feet of stream mitigation on site. Reach 1 is a 1,400 LF reach that includes the impact reach from the downstream extent of the stream impacts to a point 1,100 feet upstream of the warehouse bridge. Reach 2 extends from a point approximately 50 feet downstream of the abandoned railroad bridge to a point approximately 350 feet upstream of the bridge. The total length of Restoration Reach 2 is 400 LF.

5.3. Site Protection Instrument

Because the impact and restoration reach of Glenn's Creek flows through what is largely a commercial facility, with an established network of infrastructure, utilities, roadways, and maintenance/safety plans, it is the intention of the applicant to move the required protected stream reach downstream to a more suitable location. The technical component of the stream restoration activity will still be performed in the vicinity of the impacted reach, but no legal instrument will be offered to bind the stream and riparian area in perpetuity.

The protective covenant, in the form of a deed restriction, will be put in place on Glenn's Creek within Jim Beam-owned property from its mouth at the Kentucky River upstream for 1,800 LF (Attachment 2, Figures 5 and 6). The width of the restricted corridor is proposed to be 75 ft on each side of the centerline of the stream channel, for a total width of 150 ft. The average width of Glenn's Creek in this lower section was observed during habitat assessments to be approximately 50 ft between the ordinary high water marks on each bank. Thus the remaining buffer width will also encompass 50 feet from the ordinary high water marks on each side of the channel.

This proposed location is characterized as being of high quality, both instream and along the riparian corridor. KDOW habitat assessments performed in the lower and upper reaches of the 1,800-ft protection reach scored 150 and 167, both fully supporting aquatic uses for the Interior Plateau Ecoregion. This downstream Glenn's Creek reach is relatively remote with steep ridges and hillsides located on both sides. Unauthorized access from adjacent landowners and/or poachers is considered to be minimal and not problematic to the existing condition of the habitat.

The draft deed restriction for Glenn's Creek is found in Attachment 8.

5.4. Baseline Information

Baseline data collection for the Glenn's Creek restoration reaches was conducted post-activity both before (ETC) and after (Stantec) the April 2008 flood event. Comprehensive reporting of the raw data is located in Attachments 3 and 5. Parameters integral to the design of restoration reaches is presented in Table 2. In general, the riffle cross section data show a migration of stream types, from B to F, within the impacted reach. This is a channel evolution typical of streams out of equilibrium, likely resulting from excessive bed load, increases in flow from upstream development, and lack of stable vegetative protection.

Table 2. Glenn's Creek geomorphic stream data summary collected post-flood (Stantec).

EXISTING STREAM DATA	
Drainage Area (sq. mi.)	33
Bedslope (%)	0.50
Stream Type	F3/1
Pfankuch Rating	76
Particle Classification	cobble/bedrock
Valley Type	II and VI
CROSS SECTION 1	
D_{bkf} (ft)	3.12
W_{bkf} (ft)	69.23
A_{bkf} (ft^2)	216
D_{max} (ft)	4.74
Entrenchment Ratio	1.72
w/D	22.19
Stream Type	B3c
Pfankuch Stability	Fair
CROSS SECTION 2	
D_{bkf} (ft)	3.4
W_{bkf} (ft)	64.12
A_{bkf} (ft^2)	218.3
D_{max} (ft)	4.89
Entrenchment Ratio	1.3
w/D	18.86
Stream Type	F3
Pfankuck Stability	Good

5.5. Determination of Credits

The USACE has indicated through formal and informal correspondence the required mitigation ratio to satisfy after-the-fact regulatory compliance shall be 1.5:1. Thus 1,800 LF of restoration activities are proposed for the original 1,200 LF of stream impacts.

5.6. Mitigation Work Plan

Proposed In-stream Restoration Activities

The conceptual mitigation plan outlining instream restoration activities is located in its entirety in Attachment 3 and exhibited in Attachment 4. It consists of the following components:

- Removal of the low water crossing immediately upstream of the warehouse facility bridge;
- Installation of cross vanes upstream and downstream of the warehouse facility bridge to reduce stress on stream banks, direct flow toward the center of the bridge opening away from its embankments, to maintain the bankfull channel and to provide effective fish passage through the reach;
- Construction of J-hook vane structures in the bend upstream of the abandoned railroad bridge to reduce bank stresses and maintain pools in the bend;
- Imbricated stone toe structures will be used to reconstruct eroded banks that may be out of the effective reach of cross vanes and j-hook vanes;
- Removal of protrusions from the warehouse facility bridge;
- Raise west bank downstream of bridge to promote sediment transport;
- Remove concrete remnants and abandoned pipes in stream;
- Remove abandoned piers from the stream;
- The stream will be designed as a B3/1c stream type. Bankfull dimensions of riffle sections for the design are given in Table 3 below;

Table 3. Bankfull Parameters for Design of Stream Restoration Reaches.

Bankfull Slope	0.006 ft/ft
Bankfull Depth (Average)	4.4 ft
Bankfull Depth (Maximum)	5.2 ft
Bankfull Area	215 sq. ft.
Bankfull Width	48 ft
w/D Ratio	18
Entrenchment Ratio	1.6 to 2.2
Restoration Type	Priority II
Design Stream Type	B3/1c

Proposed Riparian Enhancement

Riparian planting zones are included in the plan to enhance existing riparian vegetation and to establish riparian vegetation in areas where it does not currently exist. The riparian vegetation will provide habitat for wildlife along the stream corridor and will improve aquatic habitat by providing shade to cool the stream and detritus to support the macroinvertebrate community. The riparian vegetation will also help stabilize stream banks within the reach.

The proposed configuration of enhancement zones within the Old Crow Warehouse Facility incorporates several factors, such as the location of existing wooded riparian areas, security fencing, stream bank retaining walls, paved/gravel drives, bridges, and utilities. Planting areas are proposed throughout the 1,800-ft restoration reaches, with a lateral width ranging from approximately 25 to 100 feet (Attachment 2 - Figure 4). All opportunities to foster advantageous plant communities along the stream were fully utilized. Where the riparian area is currently maintained as mowed turf, planting specifications will follow those outlined below for Planting Zone 1. Where existing woody vegetation already exists, Planting Zone 2 specifications will be adhered to.

Planting Zone 1: Currently maintained areas will be planted above the bankfull elevation with shrub and tree from Lists A and B below. This will include the installation of at least 300 bare-root stems per acre and will be comprised of a minimum of 4 species from each list. Four separate locations are delineated in Zone 1 and, in total, represent an area of 1.43 acres

Planting Zone 2: Much of the riparian area is currently sparsely wooded, with American sycamore (*Platanus occidentalis*), box elder, (*Acer negundo*), silver maple, (*Acer saccharinum*), and slippery elm (*Ulmus rubra*) dominating the overstory layer. These soft mast species will be supplemented with trees and shrubs, as in Zone 1, that are considered beneficial to wildlife and the local ecosystem. In Zone 2, 150 stems per acre will be planted to supplement existing diversity. Mechanical removal of exotic woody shrub species will be conducted to ensure the growth potential of planted material.

Within one year after completion of the subdivision, the mitigation site will be planted as described above with native tree and shrubs found in Lists A and B. At least five species of trees will be used. Not more than 25% of the total number will be any one species. Bare rooted material will be used for trees/shrubs, however if larger containerized plantings are determined to be preferable, the agencies will be consulted for subsequent reduction in planting rates. Trees and shrubs will not be planted in rows, but rather scattered and clumped in defined planting zones. The planting will be done during the dormant season to foster successful growth. Genotypes native to the state will be used, and, when possible, local nursery stock will be employed.

List A. Trees for Riparian Zone Planting

Pin oak	*Quercus palustris*
Shagbark Hickory	*Carya ovata*
Shellbark Hickory	*Carya laciniosa*
Black gum	*Nyssa sylvatica*
Silver Maple	*Acer saccharinum*
Bur Oak	*Quercus macrocarpa*
Yellow poplar	*Liriodendron tulipifera*
Sweetgum	*Liquidambar styraciflua*
Black Walnut	*Juglans nigra*

List B. Shrubs for Riparian Zone Planting

Southern Arrowwood	*Viburnum dentatum*
Silky Dogwood	*Cornus ammomum*
Elderberry	*Sambucus canadensis*
Spicebush	*Lindera benzoin*
Possum Haw	*Viburnum acerifolium*
Gray Dogwood	*Cornus racemosa*
Winterberry	*Ilex verticillata*

5.7. Maintenance Plan

Instream Structures and Habitat: All constructed features described in the conceptual plan will be maintained as needed in order to preserve their structural integrity and continued functionality. To minimize future problems with the components of the plan, implementation of the design will be overseen by qualified personnel experienced in the supervision of natural channel design techniques.

Riparian Planting: Plantings may be supplemented as needed in accordance with performance standards should significant mortality occur from wildlife browsing, competition from exotic species, and or other unforeseen stresses.

Bridge Maintenance: At the discretion of BGSW operations managers, debris jams in the immediate vicinity of both the railroad and warehouse facility bridges may require periodic removal if the post-implementation cross sectional area of the passing flow is significantly impinged. Removal will be conducted in accordance with the following guidelines:

- Material will be removed using the "one-step removal" process. The one step removal process involves lifting material from the stream and placing it outside of the stream channel.
- Backhoes and front-end loaders, will be used for this activity. Bulldozers will not be utilized within the stream as they cause unnecessary disturbance to the stream channel.
- Removal of materials will be conducted only during low-flow periods, generally late summer or fall.
- Removal of materials will not be conducted during the fish-spawning season (April 15th to June 15th).
- Substrate will not be pushed up against the sides of the stream in an attempt to stabilize the stream bank or for any other reason.
- The terms of Nationwide Permit 3 for maintenance activities will be strictly followed. Pre-Construction Notifications will be provided to both KDOW and USACE prior to the commencement of debris removal activities.

5.8. Performance Standards

Instream Structures and Habitat: The stable stream condition for this reach of Glenn's Creek has been previously identified as a B3/1c stream type. The range of conditions that define this stream type will comprise the performance standards for geomorphic parameters. During monitoring reporting the following parameters must meet the accompanying values:

- Entrenchment Ratio: 1.4 - 2.2
- Width/Depth Ratio: >12
- Sinuosity: >1.2
- Slope: <0.02
- Dominant Particle Size: bedrock/cobble

If the preceding criteria are not being met, an investigation will ensue to identify the causal factors. In certain cases, watershed influences outside the control of BGSW, may be the driving force, and no reasonable remedies will be available under the auspices of this regulatory compliance.

Riparian Planting: The planted areas in Zone 1 (currently maintained) will have a density of 300 stems/acre after the completion of three growing seasons. Up to 50% of the 300 stems/acre may be volunteers. No more than 10% of the herbaceous cover will be comprised of invasive exotic species, as listed by Kentucky Exotic Pest Plant Council as severe and significant threats (http://www.se-eppc.org/ky/list.htm). Planted areas in Zone 2 (currently wooded) will have similar requirements, except 150 stems/acre will be minimum density.

5.9. Monitoring Plan

In accordance with the USACE 2008 Compensatory Mitigation Rule for Losses of Aquatic Resources (33 CFR 325) and KDOW Draft Stream Mitigation Guidelines (2007), annual monitoring will be conducted throughout the proposed Glenn's Creek restoration reaches. The monitoring period will continue for a period of five years, beginning with an as-built report in the year in which construction was completed (Year 0) and ending after five full calendar years following construction. Annual monitoring reports will be submitted to KDOW and USACE by December 31st of each year.

The components of the monitoring plan will include the following items:

As-Built Survey: Upon completion of restoration activities, an as-built drawing will be submitted to KDOW/USACE. It will include a longitudinal profile, cross sections, placed in representative habitat features (riffle, run, pool, glide) and a planview drawing.

Performed: Years 0 (post-construction) & 3

Riffle/Channel Pebble Counts and Bar Samples: Pebble counts will be taken following the modified Wolman procedure (Rosgen 1993). Sediment rating curves will be presented in the monitoring report. Bar samples will be taken at a representative depositional bar in the restoration reaches.

Performed: Year 3

Permanent picture stations: These will be established where pictures can be taken biannually (summer/winter). Photographic documentation will be submitted that clearly shows the condition of representative structures, outside meander bends, bank stabilizations, in-channel habitat features, and riparian habitat.

Performed: Years 1-5

Vegetative Monitoring: Ten (10) vegetation sample points will be set along the riparian planting zones that adequately represent the different existing habitats and proposed planting schemes. Reporting will include species composition, density, percent cover, dominant species per stratum, percent survival of planted trees and shrubs, percent exotics, and stems/acre for planted/volunteer trees and shrubs.

Performed: Years 1-5

Habitat assessment: KDOW habitat forms will be completed for each distinct project reach. Habitat assessment procedures follow those outlined in Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (Barbour et al. 1999).

Performed: Years 1-5

5.10. Long-Term Management Plan

BGSW is committed to the long-term success of the mitigation project. Glenn's Creek serves as a central geographic feature at the Old Crow Warehouse Facility and the future stability of the stream plays a vital role in the operational sustainability and protection of the facility's assets. While no formal or legal instrument is in place for the protection of the restoration reach, BGSW will enact internal controls to ensure the viability of riparian planting areas and instream control structures.

The downstream reach of Glenn's Creek proposed for long-term deed restriction will be legally bound under the restrictive recitals contained in the protective instrument. BGSW will adopt internal controls to uphold these conditions. Further, to the extent possible, BGSW will prevent unauthorized third-party access to the property that may have the potential to violate conditions of the deed restriction.

5.11. Adaptive Management Plan

The adaptive management plan is intended to address unforeseen changes in site conditions or other components of the compensatory mitigation project. The adaptive management plan will guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success. In general the following guidelines will be followed by BGSW:

- If the compensatory mitigation project cannot be constructed in accordance with the proposed mitigation plan, BGSW will notify USACE/KDOW and seek guidance for approved remedies.

- If monitoring or other information indicates that the compensatory mitigation project is not progressing towards meeting its performance standards as anticipated, BGSW will notify USACE/KDOW as soon as possible and seek guidance for approved remedies.

- Approved remedies may include site modifications, design changes, revisions to maintenance requirements, and/or revised monitoring requirements. The measures will be designed to ensure that the modified compensatory mitigation project provides aquatic resource functions comparable to those described in the mitigation plan objectives.

5.12. Financial Assurances

Beam Global Spirits & Wine, Inc. is a multi-national corporation, with its Kentucky roots dating to the year 1795. Its operating managers and corporate leadership are keenly aware of the importance of sound environmental stewardship and the associated responsibility under the regulatory framework. In fact, the streams and rivers that flow past its distilleries comprise the

main ingredient of its highly-successful products - water. BGSW offers assurances, with the backing of a publically-traded global enterprise, that the conditions set forth in this mitigation plan will be followed. Where adaptations to unforeseen conditions are warranted, the USACE and KDOW will be consulted and a resolution will be negotiated appropriately.

No financial assurances in the form of performance bonds, escrow accounts, casualty insurance, letters of credit, or other instruments are proposed by BGSW at this time.

6. Summary of 404/401 Compensatory Mitigation

As compensatory mitigation for the unauthorized removal of streambed substrate at the Old Crow Warehouse Facility, Woodford County, Kentucky, Beam Global Spirits and Wines proposes to perform compensatory mitigation activities consisting of the following:

- 1,800 linear feet of Glenn's Creek proposed for restoration activities at the Old Crow Warehouse Facility. The conceptual plan includes:
  - Removal of the low water crossing;
  - Installation of cross vanes and step/pools;
  - Construction of J-hook vane structures;
  - Imbricated Stone Toe Structures;
  - Removal of protrusions from the warehouse facility bridge;
  - Removal of artificial debris from the stream channel;
  - Reshape banks to promote sediment transport; and
  - The stream will be designed as a B3/1c stream type.

- 3.4 acres of riparian habitat will be planted with woody species.

- 1,800 linear feet of high-quality Glenn's Creek habitat proposed for deed restriction at its Kentucky River confluence.

Attachment 1 - 404/401 Permit Applications

Department of the Army Permit Application

Kentucky Division of Water WQC Application

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT (33 CFR 325)	OMB APPROVAL NO. 0710-0003 Expires December 31, 2004

The Public burden for this collection of information is estimated to average 10 hours per response, although the majority of applications should require 5 hours or less. This includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302; and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research and Sanctuaries Act, 33 USC 1413, Section 103. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE *(an agent is not required)*
Beam Global Spirits & Wines, Inc.	**Lee Droppelman, Principal Scientist** **Eco-Tech Consultants, Inc.**
6. APPLICANT'S ADDRESS	9. AGENT'S ADDRESS
P O Box 426 **3200 Georgetown Road** **Frankfort, KY 40601**	**931 East Main Street** **Frankfort, KY 40601**
7. APPLICANT'S PHONE NOS. W/AREA CODE	10. AGENT'S PHONE NOS. W/AREA CODE
a. Residence b. Business **(502)695-3010**	a. Residence b. Business **(502) 695-8060**

11. STATEMENT OF AUTHORIZATION

I hereby authorize **Lee Droppelman** to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

APPLICANT'S SIGNATURE DATE

NAME, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE *(see instructions)*

Jim Beam Old Crow Warehouse Facility

13. NAME OF WATERBODY, IF KNOWN *(if applicable)*	14. PROJECT STREET ADDRESS *(if applicable)*
Glenn's Creek, a direct tributary to the Kentucky River	**Old Crow Warehouse Facility** **3675 McCracken Pike** **Versailles, KY 40383**
15. LOCATION OF PROJECT **Woodford/Franklin** (COUNTY) **Kentucky** (STATE)	

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

17. DIRECTIONS TO THE SITE

From I-64 exit 53, go north on US 127 0.75m to CR 676. Go right/east 3.2m to CR 1659, Martin Luther King Blvd. MLK Blvd turns into Glenn's Creek Road. Go south on 1659 3.7m to Old Crow Warehouse Facility. Security gate is on right side.

18. Nature of Activity *(Description of project, include all features)*

Stream bed substrate and debris were mechanically removed to the underlying bedrock within the ordinary high water limits of the channel. Material was pushed against both banks and also stockpiled within the floodplain. Approximately 1,200 linear feet of stream bed was affected, resulting in the displacement of over 2,500 cu yds of material. Within the vicinity of an existing access bridge, bedrock was further broken and removed to increase the flow capacity under the bridge.

19. Project Purpose *(Describe the reason or purpose of the project, see instructions)*

The purpose of the project was to remove the accumulated rock and debris around the access bridge in an attempt to increase the flow capacity and reduce flooding impacts to adjacent property structures.

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Material was excavated and deposited along stream banks and stockpiled on the adjacent floodplain.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards

Approximately 2,500 cu yd of unconsolidated stream bed substrate and debris. Particle size ranges from fine silt/sand to boulders and large woody debris.

22. Surface Area in Acres of Wetlands or Other Waters Filled *(see instructions)*

Approximately 25,000 sq ft of stream bed was affected by the sediment removal activities.

23. Is Any Portion of the Work Already Complete? Yes **X** No _____ IF YES, DESCRIBE THE COMPLETED WORK

All of the previously described activities have been completed.

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

See supporting documents.

25. List of Other Certifications or Approvals/Denials Received from other Federal, State, or Local Agencies for Work Described in This Application

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

*Would include but is not restricted to zoning, building and flood plain permits

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT	DATE	SIGNATURE OF AGENT	DATE
	9/8/2008		9/8/2008

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: WhoeBeaver, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES & ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRNOMENTAL PROTECTION
DIVISION OF WATER

APPLICATION FOR PERMIT TO CONSTRUCT ACROSS OR ALONG A STREAM AND / OR WATER QUALITY CERTIFICATION

Chapter 151 of the Kentucky Revised Statutes requires approval from the Division of Water prior to any construction or other activity in or along a stream that could in any way obstruct flood flows or adversely impact water quality. *If the project involves work in a stream, such as bank stabilization, dred'LinL' or relocation, you will also need to obtain a 401 Water Quality Certification (WQC) from the Division of Water.* This completed form will be forwarded to the Water Quality Branch for WQC processing. The project may not start until all necessary approvals are received from the KDOW. For questions concerning the WQC process, contact the WQC section at 502/564-3410.

If the project will disturb more than 1 acre of soil, you will also need to complete the attached Notice of Intent for Storm Water Discharges, and return both forms to the Floodplain management Section of the KDOW. This general permit will require you to create an implement an erosion control plan for the project.

1. **OWNER:** Beam Global Spirits and Wines, Inc. (BGSW)
   Give name of person(s), company, governmental unit, or other owner of proposed project.
   MAILING ADDRESS: P O Box 426 3200 Georgetown Road Frankfort KY 40601
   TELEPHONE #: (502) 695-3010 **EMAIL:**
2. **AGENT:** Lee Droppelman, Principal Scientist, Eco-Tech Consultants, Inc.
   Give name of person(s) submitting application, if other than owner.
   ADDRESS: 931 East Main Street Frankfort KY 40601
   TELEPHONE #: (502) 695-8060 **EMAIL:** ldroppelman@ecotechinc.com
3. **ENGINEER:** **P.E. NUMBER:**
   Contact Division of Water if waiver can be granted.
   TELEPHONE #: **EMAIL:**
4. **DESCRIPTION OF CONSTRUCTION:**
   Describe the type and purpose of construction and describe stream impact

Stream bed substrate and debris were mechanically removed to the underlying bedrock within the ordinary high water limits of the channel. Material was pushed against both banks and also stockpiled within the floodplain. Approximately 1,200 linear feet of stream bed was affected, resulting in the displacement of over 2,500 cu yds of material. Within the vicinity of an existing access bridge, bedrock was further broken and removed to increase the flow capacity under the bridge.

5. **COUNTY:** Woodford **NEAREST COMMUNITY:** Versailles, KY
6. **USGS QUAD NAME** Frankfort East, KY **LATITUDE/LONGITUDE:** 38.14696 / -84.83907
7. **STREAM NAME:** Glenn's Creek **WATERSHED SIZE (in acres):** 21,120 (33 sq mi)
8. **LINEAR FEET OF STREAM IMPACTED:** 1,200
9. **DIRECTIONS TO SITE:**

From I-64 exit 53, go north on US 127 0.75m to CR 676. Go right/east 3.2m to CR 1659, Martin Luther King Blvd. MLK Blvd turns into Glenn's Creek Road. Go south on 1659 3.7m to Old Crow Warehouse Facility. Security gate is on right side.

10. **IS ANY PORTION OF THE REQUESTED PROJECT NOW COMPLETE?** X Yes No If yes, identify the completed portion on the drawings you submit and indicate the date activity was completed. DATE: 9/2007

11. **ESTIMATED BEGIN CONSTRUCTION DATE:** Completed

12. **ESTIMATED END CONSTRUCTION DATE:** Completed

13. **HAS A PERMIT BEEN RECEIVED FROM THE US ARMY, CORPS of ENGINEERS?** ☐ Yes X No If yes, attach a copy of that permit.

14. **THE APPLICANT *MUST* ADDRESS PUBLIC NOTICE:**

(a) PUBLIC NOTICE HAS BEEN GIVEN FOR THIS PROPOSAL BY THE FOLLOWING MEANS:

____ **Public notice in newspaper having greatest circulation in area** (provide newspaper clipping or affidavit)

____ **Adjacent property owner(s) affidavits** (Contact Division of Water for requirements.)

(b) X **I REQUEST WAIVER OF PUBLIC NOTICE BECAUSE:**

Public Notice to be completed under USACE 404 permitting process

Contact Division of Water for requirements.

15. **I HAVE CONTACTED THE FOLLOWING CITY OR COUNTY OFFICIALS CONCERNING THIS PROJECT:**

Give name and title of person(s) contacted and provide copy of any approval city or county may have issued.

16. **LIST OF ATTACHMENTS:**

List plans, profiles, or other drawings and data submitted. Attach a copy of a 7.5 minute USGS topographic map clearly showing the project location.

See supporting documents

17. I, BGSW (owner) **CERTIFY THAT THE OWNER OWNS OR HAS EASEMENT RIGHTS ON ALL PROPERTY ON WHICH THIS PROJECT WILL BE LOCATED OR ON WHICH RELATED CONSTRUCTION WILL OCCUR** (for dams, this includes the area that would be impounded during the design flood).

18. **REMARKS:**

I hereby request approval for construction across or along a stream as described in this application and any accompanying documents. To the best of my knowledge, all the information provided is true and correct.

SIGNATURE: _____

Owner or Agent sign here. (If signed by Agent, a Power of Attorney should be attached.)

DATE: 9/8/2008

SIGNATURE OF LOCAL FLOODPLAIN COORDINATOR: Patricia D. Clubb

Permit application will be returned to applicant if not properly endorsed by the local floodplain coordinator.

DATE: Sept 8, 2008

SUBMIT APPLICATION AND ATTACHMENTS TO:

Floodplain Management Section
Division of Water
14 Reilly Road
Frankfort, KY 40601

Attachment 2 - Figures

Fig. 1: Project Vicinity Topographic Map

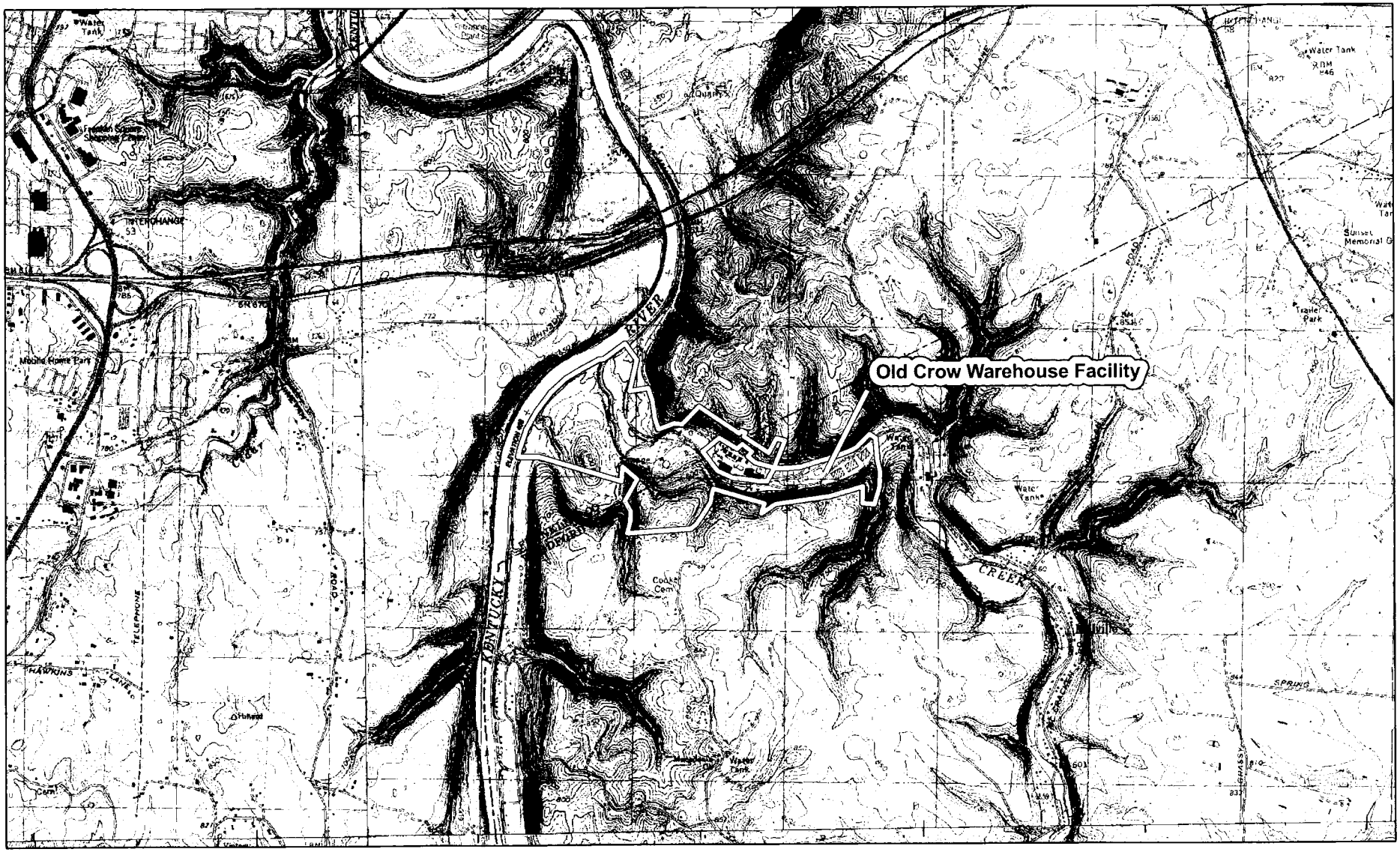
Fig. 2: Project Site Aerial Map

Fig. 3: Impact Area Map

Fig. 4: Riparian Vegetation Enhancement Map

Fig. 5: Proposed Protection Reach Topographic Map

Fig. 6: Proposed Protection Reach Aerial Map



N

Legend

Jim Beam Property Boundary

1 inch equals 3,000 feet

JIM BEAM OLD CROW WAREHOUSE FACILITY WOODFORD COUNTY, KY

Feet
0 800 1,600 3,200 4,800 6,400

Imagery Source:
USGS 7.5 Minute Topographic Maps

FIGURE 1

PROJECT VICINITY TOPOGRAPHIC MAP

ETC

Drawn by: PLD	Print Date: 9/3/08
Prepared for: Jim Beam Brands Co.	
ETC Project #: JV2008004	

N

Legend

Jim Beam Property Boundary

1 inch equals 1,500 feet

JIM BEAM OLD CROW WAREHOUSE FACILITY WOODFORD COUNTY, KY

Feet
0 440 880 1,760 2,640 3,520

Imagery Source:
Kentucky FSA NAIP Imagery

FIGURE 2

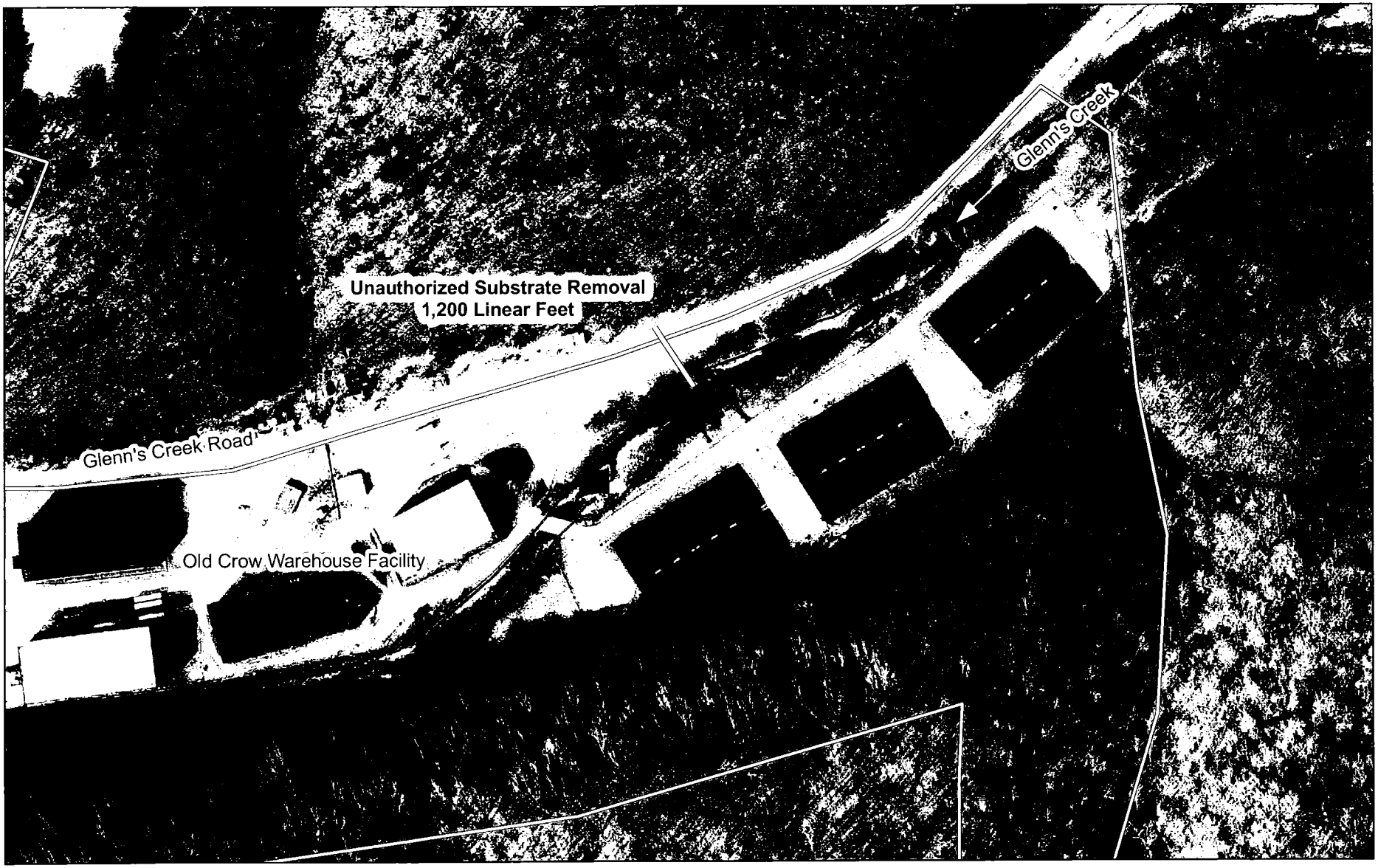
PROJECT SITE AERIAL MAP

ETC

Drawn by: PLD | Print Date: 9/3/08

Prepared for: Jim Beam Brands Co.

ETC Project #: JV2008004



N

Legend

Jim Beam Property Boundary

Stream Impact Area

1 inch equals 250 feet

JIM BEAM OLD CROW WAREHOUSE FACILITY WOODFORD COUNTY, KY

0 70 140 280 420 560 Feet

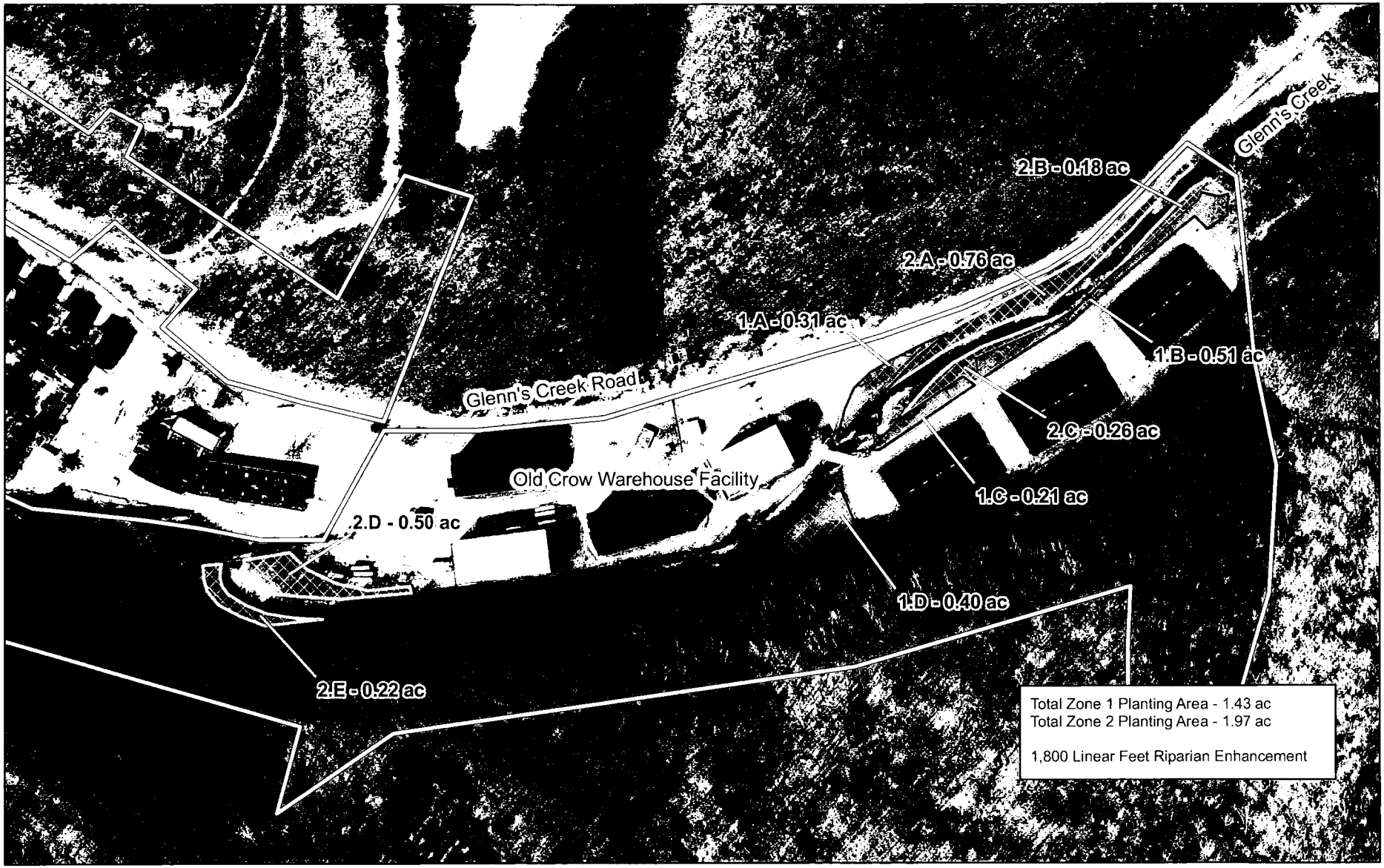
Imagery Source:
USGS High Resolution Orthoimagery, Frankfort, KY (2006)

FIGURE 3

STREAM IMPACT AREA MAP

ETC

Drawn by: PLD	Print Date: 9/3/08
Prepared for: Jim Beam Brands Co.	
ETC Project #: JV2008004	



N

Legend

- Planting Zone 1
- Planting Zone 2
- **Jim Beam Property Boundary**

1 inch equals 350 feet

JIM BEAM OLD CROW WAREHOUSE FACILITY WOODFORD COUNTY, KY

0 100 200 400 600 800 Feet

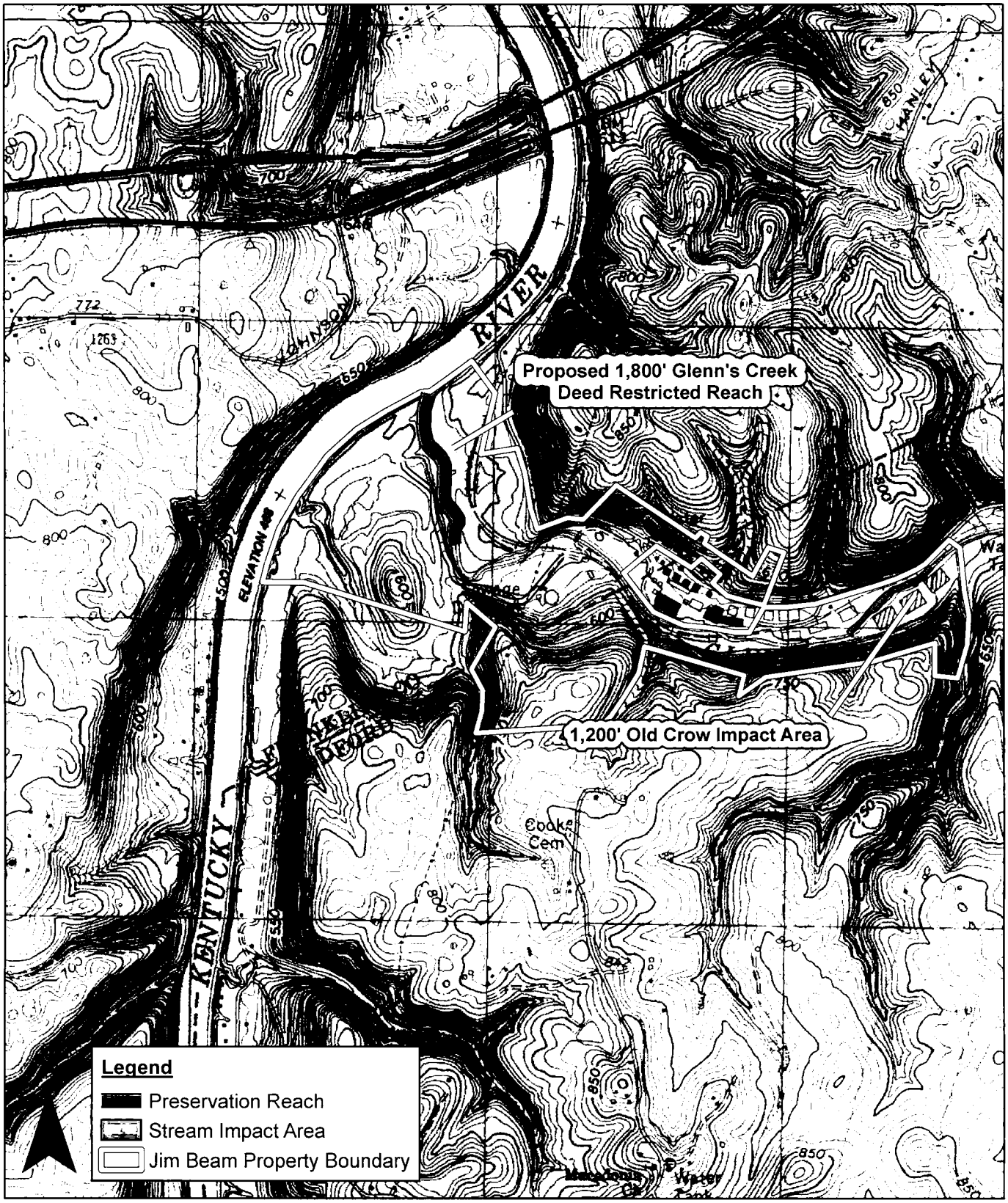
Imagery Source:
USGS High Resolution Orthoimagery, Frankfort, KY (2006)

FIGURE 4

RIPARIAN VEGETATION ENHANCEMENT MAP

ETC

Drawn by: PLD	Print Date: 9/3/08
Prepared for: Jim Beam Brands Co.	
ETC Project #: JV2008004	



JIM BEAM OLD CROW WAREHOUSE FACILITY
WOODFORD COUNTY, KY

0 425 850 1,700 2,550 3,400 Feet

Imagery Source:
USGS 7.5 Minute Topogrpahic Map, Frankfort East, KY

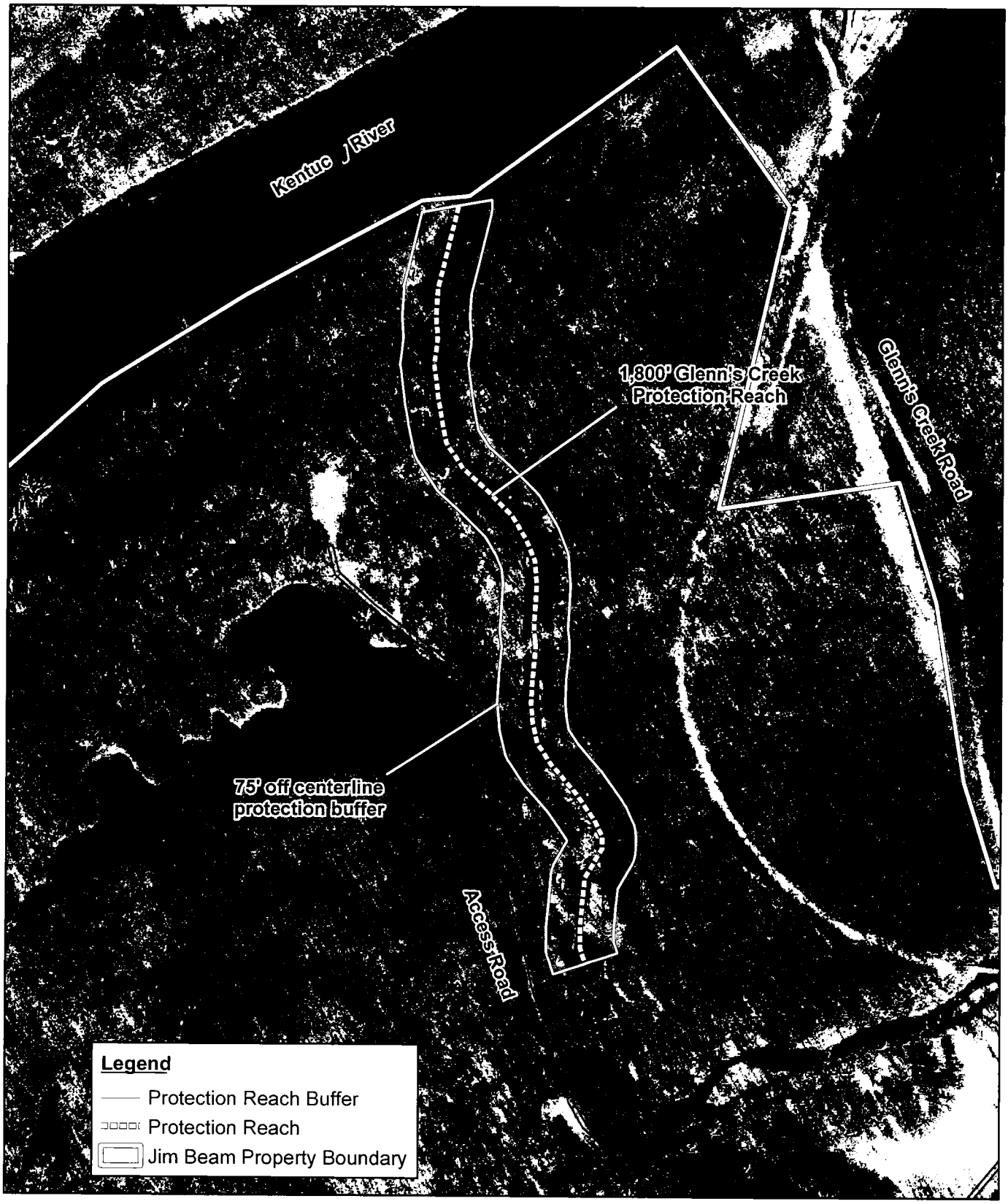
FIGURE 5

PROPOSED PROTECTION REACH TOPOGRAPHIC MAP

FRANKLIN COUNTY, KY

ETC

Drawn by: PLD	Print Date: 9/3/08
Prepared for: Jim Beam Brands Co.	
ETC File #: JV2008004	



JIM BEAM OLD CROW WAREHOUSE FACILITY
WOODFORD COUNTY, KY

0 80 160 320 480 640 Feet

Imagery Source:
USGS High Resolution Orthoimagery, Frankfort, KY (2006)

FIGURE 6

PROPOSED PROTECTION REACH AERIAL MAP

FRANKLIN COUNTY, KY

ETC

Drawn by: PLD	Print Date: 9/3/08
Prepared for: Jim Beam Brands Co.	
ETC File #: JV2008004	

Attachment 3 - Glenns Creek Watershed and Stream Assessment Report*

Completed by Stantec Consulting Services, Inc. (2008)

*Post April 2008 Flooding

Stantec

Glenns Creek Watershed and Stream Assessment

USACE LRL-2007-01461-pjl

Beam Global Wine and Spirits, Inc.
Old Crow Distillery
Woodford County, Kentucky

KDOW AI NO. 40205

September 5, 2008

Table of Contents

1.0 Introduction

Stantec Consulting Services, Inc. (Stantec) was contracted by Beam Global Wine and Spirits, Inc. to conduct an assessment of stream and watershed conditions at its Old Crow Distillery in Woodford County, Kentucky and to provide a conceptual plan for mitigation of stream impacts caused by maintenance activities in the creek. The work is being conducted subsequent to a geomorphic assessment conducted by Eco-Tech Consultants, Inc. (Eco-Tech Consultants, Inc., 2008) to complete an application for a Water Quality Certificate to the Kentucky Division of Water (KDOW). Stantec was contracted to conduct this study following a rain event on April 4-5, 2008, during which approximately five (5) inches of rainfall fell within the Glenns Creek Watershed.

The April 4-5 event caused severe aggradation of the Glenns Creek in the impacted reach. The purpose of this study is to;

1.0 Evaluate watershed development and its impact on stream flows and sediment loads at the Old Crow Distillery;

2.0 Provide a geomorphic assessment of the reach that focuses on the sediment transport capacity of the creek;

3.0 Develop hydrologic and hydraulic models to evaluate the potential for flood reduction along the reach and to evaluate water surface slopes that are critical to sediment transport; and

4.0 Develop a conceptual plan for presentation to the Kentucky Division of Water and U.S. Army Corps of Engineers.

5.0 This report is presented in two major sections. Section 2.0 presents the purpose, methods, models and results of the watershed assessment and hydrologic, hydraulic and sediment transport analyses completed in this study. Section 3.0 presents the goals, analysis and design of the conceptual plan. A summary of the study and the conceptual plan are provided in Section 4.0.

2.0 Watershed Assessment, Hydrologic, Hydraulic and Sediment Transport Analyses

2.1 WATERSHED ASSESSMENT

The purpose of the watershed assessment is (1) to evaluate current land use impacts on the stream; (2) to provide a means of evaluating existing stream conditions upstream and downstream of the project site; and (3) to evaluate changes in land use that may impact stream flow rates, volumes and sediment loads at the project site. The watershed assessment includes mapping of the Glenns Creek drainage basin using the ArcView® Geographic Information System (GIS). The watershed map includes watershed boundaries, topography, streams, roads, soils, and historic aerial photography. The maps were used to evaluate land use and stream conditions as the watershed developed and to identify locations to be included in the field assessment as potential reference reaches and sediment supply sections for the analysis of the impacted reach and the design of its mitigation.

Data derived from the maps and field assessment were used to:

- model the hydrology at the project site
- analyze hydraulics at the project site
- analyze sediment transport capacity through the project reach

2.1.1 Watershed Mapping

Glenns Creek drains 33 square miles in Woodford and Franklin Counties, as shown in Figure 2.1. The watershed extends from its headwaters near the City of Versailles, north to the Kentucky River. Land uses include forest, row-crop agriculture, pasture, urban and suburban development, commercial development and industrial development. Several distilleries, both active and inactive, are located along the creek. The average watercourse bedslope for Glenns Creek is 0.50%.

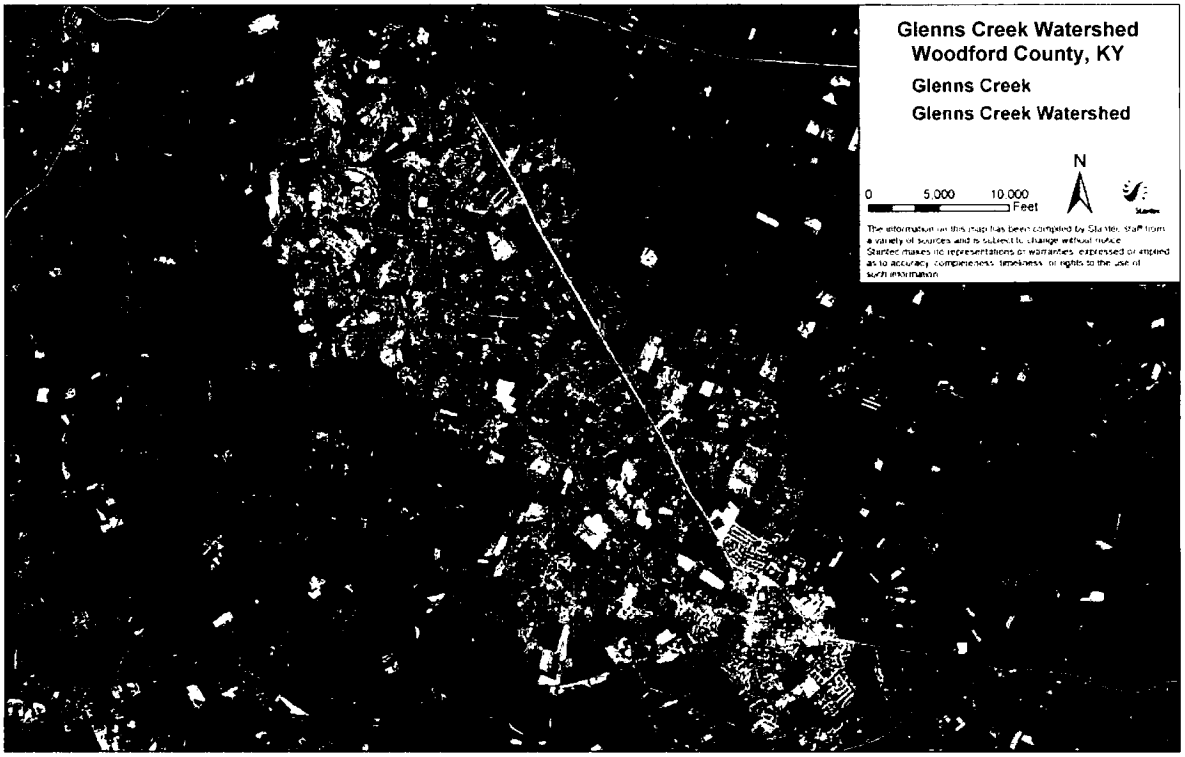


Figure 2.1: Map of the Glenns Creek Watershed in Woodford County, KY.

The aerial photography shown in Figure 2.1 was published in 2006 (Franklin County) and 2007 (Woodford County). Historical aerial photography of the watershed area from 1937, 1949, 1957, 1969 and 1980 was obtained from the Woodford County Soil Conservation District Office. Archival photographs were scanned at 200 DPI resolutions at the district's office. The GIS metadata for aerial photography, Kentucky Roads, Kentucky Rivers, topography and historical imagery is provided in Appendix A.

In addition to planning field assessments, the GIS mapping of the Glenns Creek Watershed was used to derive inputs for hydrologic analysis of the watershed and project reach.

2.1.2 Field Assessment

A desktop and field reconnaissance was completed for the project reach and other areas of interest within the watershed to determine areas of relative stability. This data was used to

identify areas within the watershed where a stable riffle cross-section could be located to use as a sediment transport reference.

The collection of geomorphic data was centered around the need for the completion the FLOWSED/POWERSED sediment transport model. Field data necessary to complete this model include the survey of a stable riffle cross-section, a longitudinal profile, sediment size distribution data, and a Pfankuch stability analysis. The FLOWSED/POWERSED model and results are presented in Section 2.5 below.

The field investigation consisted of an on-site reconnaissance of the stable reaches identified in the pre-field investigation. The sites evaluated during the field assessment are shown in Figure 2.2. After these areas were investigated in the field, it was determined that the most suitable riffles for use in the FLOWSED/POWERSED model were located in the reach upstream of the project area. Two stable riffle cross-sections were located directly upstream of the project, and were surveyed for analysis of cross-sectional area and geometry.

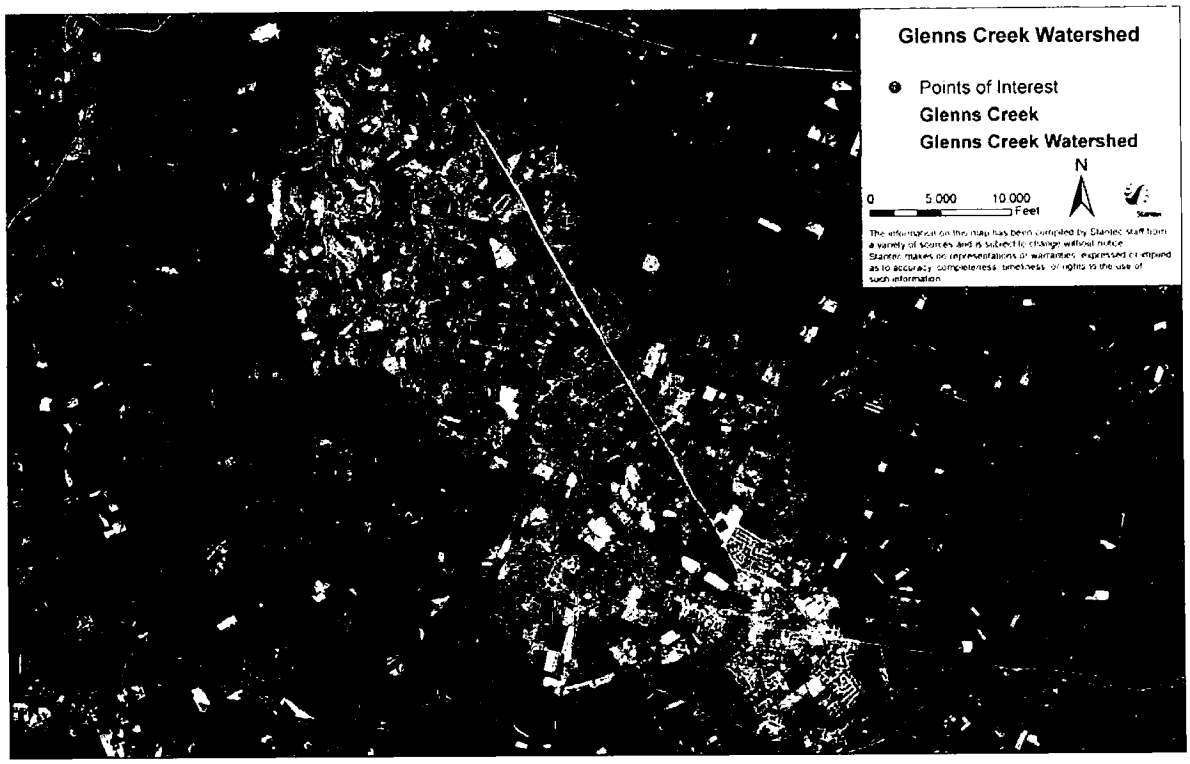


Figure 2.2: Map of points of interest along Glenns Creek.

A longitudinal profile was surveyed through the stable cross-section locations to determine elevations of the thalwag, water surface bankfull elevations along the channel. This data was used to calculate the energy slope through the cross-section and predict the discharge at bankfull stage. Wolman pebble counts were used to characterize the average sediment range in the stream channel, and to determine the typical size of the sediment on the depositional bars within the channel. Glenns Creek is an F3/1 stream type through the project reach.

The Pfankuch stability analysis was completed within the reach. It is necessary to assess the stability of the reach in order to select an appropriate of sediment rating curve in the FLOWSED/POWERSED model. The Pfankuch rating for the reach is 76, which corresponds to a "good" stability ranking for F3 streams and a "fair" ranking for B3 streams (Rosgen 2006b).

2.2 STREAM ASSESSMENT

Glenns Creek in the vicinity of the Old Crow Distillery has been impacted by maintenance work and subsequent aggradation of the bed following the storm of April 4-5, 2008. The reach includes two existing crossings: a vehicular bridge that provides access to warehouses on the south side of the creek (Warehouse Bridge) and a concrete structure that served as a low-water crossing in the past. The low-water crossing is located approximately 100 feet upstream of the Warehouse Bridge. The impacted reach of Glenns Creek extends from a point approximately 300 ft downstream of the Warehouse Bridge to a point approximately 900 feet upstream of the bridge. Figure 2.3 shows the extent of the impacted reach and the location of the existing bridge and crossing.

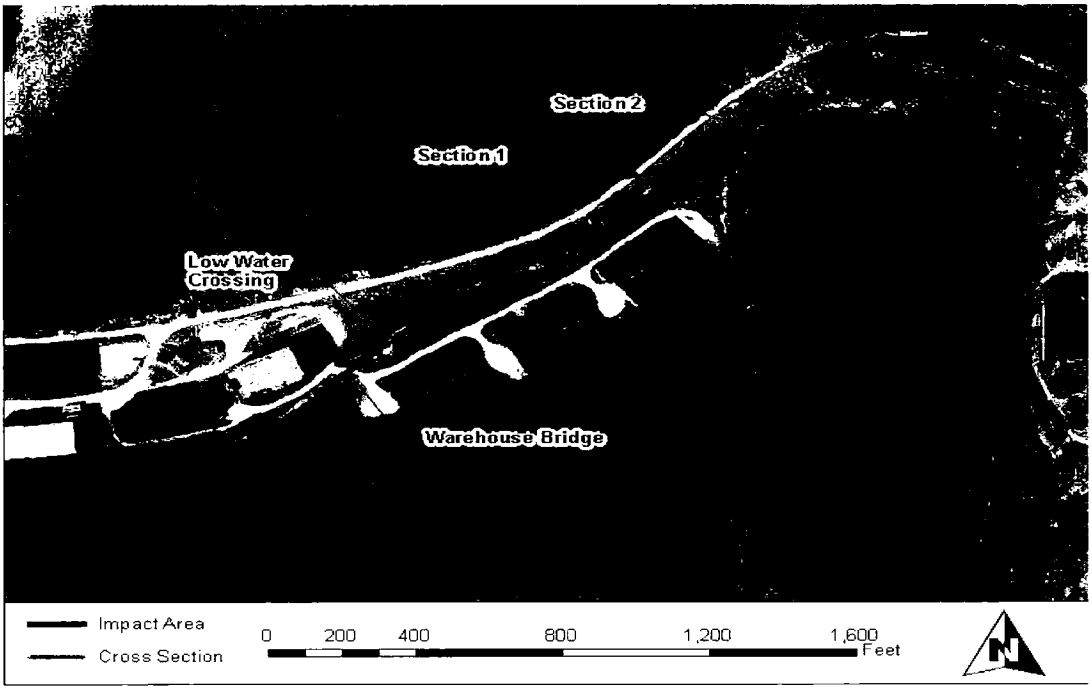


Figure 2.3: Map of Impacted Reach and Surveyed Riffle Sections.

A stream assessment was conducted in the impacted reach. The assessment was conducted for the following purposes:

- To classify the stream in its existing condition;
- To determine bankfull dimensions;
- To characterize bed and bar materials; and
- To evaluate sediment transport through the reach.

The assessment includes a geomorphic survey of riffle cross-sections, the thalweg profile, water surface profile, and sampling to characterize bed and bar material in the reach. The data collected in the stream assessment was used to determine bankfull dimension, pattern, profile, determination of the existing stream type, its potential stream type and to evaluate the sediment competency and transport capacity through the reach.

BEAM GLOBAL WINE AND SPIRITS, INC.
OLD CROW DISTILLERY
WOODFORD COUNTY, KENTUCKY

Two riffle sections (Section 1 and Section 2) were surveyed upstream of the Warehouse Bridge. The sections were located approximately 1,000 and 1,200 feet upstream of the bridge, as shown in Figure 2.3. Stream type varies in riffles through the reach between B and F types. Sections were located upstream of the bridge so that they are not impacted by backwater effects of the bridge and low-water crossing. Section 1 was selected because it is a relatively stable riffle section that is representative of B type riffles in the project reach. Similarly, Section 2 is representative of F type riffle sections in the reach. Since both sections are located near the upstream end of the project reach, they can also be used as sediment supply sections for the sediment transport analysis. Application of the FLOWSED/POWERSED model (Rosgen, 2006, 2006b) to analyze sediment transport capacity is discussed below in Section 2.5 of this report.

The profile of the thalweg including the bed, bankfull, and water surface elevations was surveyed from the upstream end of the reach downstream to the low-water crossing. The remaining profile of the reach was surveyed during the bridge survey discussed below. Table 2.1 shows the bankfull characteristics of the riffle sections.

Table 2.1: Bankfull Characteristics of Riffle Sections.

Section	Bankfull Depth, D_{bkf} (ft)	Bankfull Width, w_{bkf} (ft)	Bankfull Area, A_{bkf} (ft^2)	Maximum Depth, D_{mbkf} (ft)	Entrenchment Ratio	w/D Ratio	Stream Type
Section 1	3.12	69.23	216	4.74	1.72	22.19	B3c
Section 2	3.4	64.12	218.3	4.89	1.3	18.86	F3

Figure 2.4 shows the stream profile surveyed during the stream assessment. The profile shows the reach is dominated by rapids with shallow, irregular pools and short riffles. The lower third of the profile is a long, shallow, compound pool. Three bankfull indicators, typically point bars, were identified through the reach. The bankfull slope is 0.006 ft/ft. The stream bed alternates between cobble and bedrock through the reach. The slope is consistent with C, F and E stream types, hence the B3c classification for Section 1 above. While the top of the bank is irregular, it is consistently above bankfull elevations in the profile. This indicates that the reach is incised and a Priority II restoration is needed through the reach. A Priority II restoration reconnects the bankfull channel to a floodplain at a lower level than the original floodplain.

Identifying the valley type is an important consideration in determining a stream's potential. The stream valley is a Type II and is characterized as colluvial. The presence of bedrock in the valley and steep hillsides are also characteristic of fault controlled or Type VI valleys. B-type streams are common in both valley types. F and C channels are also found in Type VI valleys. G streams are found in both valleys when the stream is not in equilibrium. Anthropogenic activities such as dam construction and fill placement appear to have reduced gradients in the valley. Fill placement and existing buildings prevent the development of a wide floodprone area that is typical of C type streams. Considering these observations along with the existing bankfull and valley slopes, and bedrock control the potential stream type through project reach is B3/1c. Therefore, the stream restoration should be designed as a B3/1c stream type.

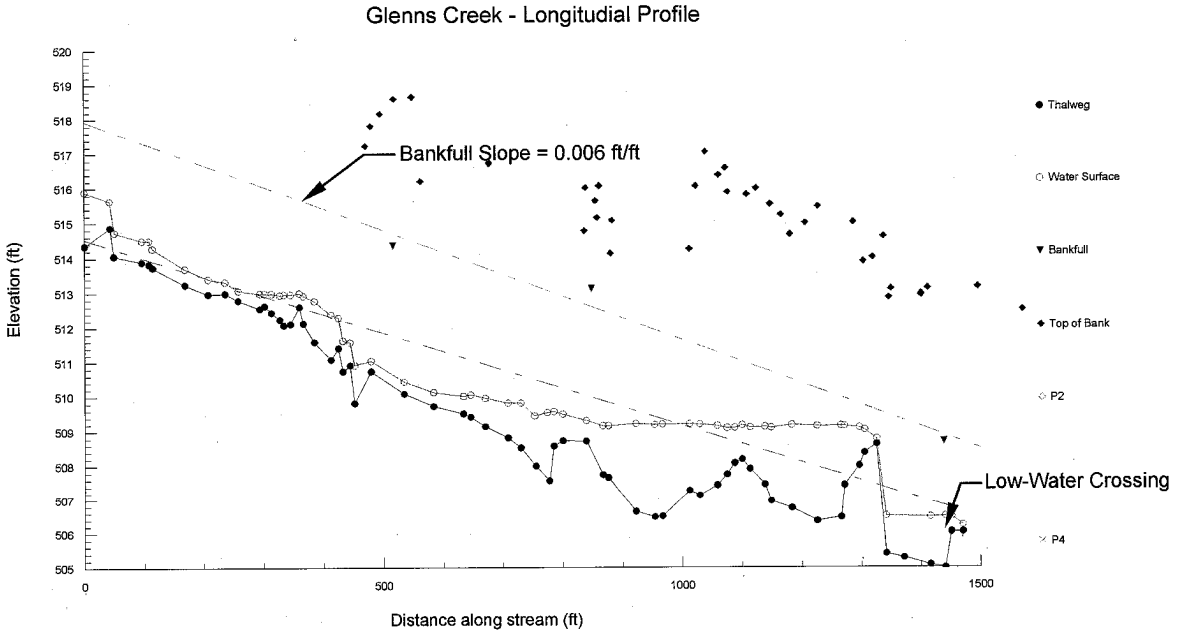


Figure 2.4: Glenns Creek Profile from Geormorphic Survey.

2.3 HYDROLOGIC ANALYSIS

Glenns Creek at the Old Crow Distillery site drains approximately 33 square miles. The watershed boundaries extend upstream to Versailles from its mouth at the Kentucky River. The mouth of the creek is approximately 1 mile downstream of the project site. The watershed consists primarily of rugged, steep terrain with a narrow floodplain.

BEAM GLOBAL WINE AND SPIRITS, INC.
OLD CROW DISTILLERY
WOODFORD COUNTY, KENTUCKY

No historical gage data was available for Glenns Creek. Therefore, peak discharges were estimated in HEC-HMS, using SCS curve number methodology to predict effective runoff.

Several methods for estimating peak discharges were considered when evaluating the hydrology of the watershed. The Woodford County Flood Insurance Study Report (FEMA 1977) was reviewed. The estimated 100-year discharge was listed as 13,300 cubic-feet-per-second (cfs). This estimate was based on "a study of all U.S. Geological Survey gauging stations in the area, which exhibited a high runoff rate for small drainage area." The intent was to use a similar method in the current study, but a listing of the basins used in the previous assessment was not available.

USGS regression equations (Hodgkins and Martin 2003) were then used to estimate a 100-year discharge of 6,300 cfs. The 100-year regression equation for the Glenns Creek region is:

$$Q_{100} = 538DA^{0.704}$$

where *DA* = drainage area in square miles.

Since the equation used to predict this flow was based on only one parameter, drainage area, and the value differed significantly from the FIS value, the SCS method was also used to estimate the peak discharge and compare to the FIS value.

The overall watershed for Glenns Creek was delineated using ten-foot contours on USGS topographic maps and the watershed divided into seventeen subbasins, ranging from 0.92 to 3.12 square miles. The subbasins are shown in Figure 2.5. The curve number for each subbasin was estimated using soil and land use data. Landuse throughout the basin was determined from review of 2006 aerial imagery. Further, 1937 aerial imagery was obtained, allowing for assessment of relative changes in discharge as a result of development within the watershed. Time of concentration was estimated using the SCS Lag Time Equation to predict lag time (T_{LAG}) for each subbasin.

The SCS Lag Time Equation appears as:

$$T_{LAG} = L^{0.8}\frac{(S+1)^{0.7}}{1900\sqrt{Y}}$$

where *L*= hydraulic length of the subbasin in feet; *S*= maximum retention in the subbasin in inches, and is defined by *S = 1000/CN – 10*; *CN* = SCS curve number for the subbasin as defined by the loss method; and *Y*= subbasin slope in percent.

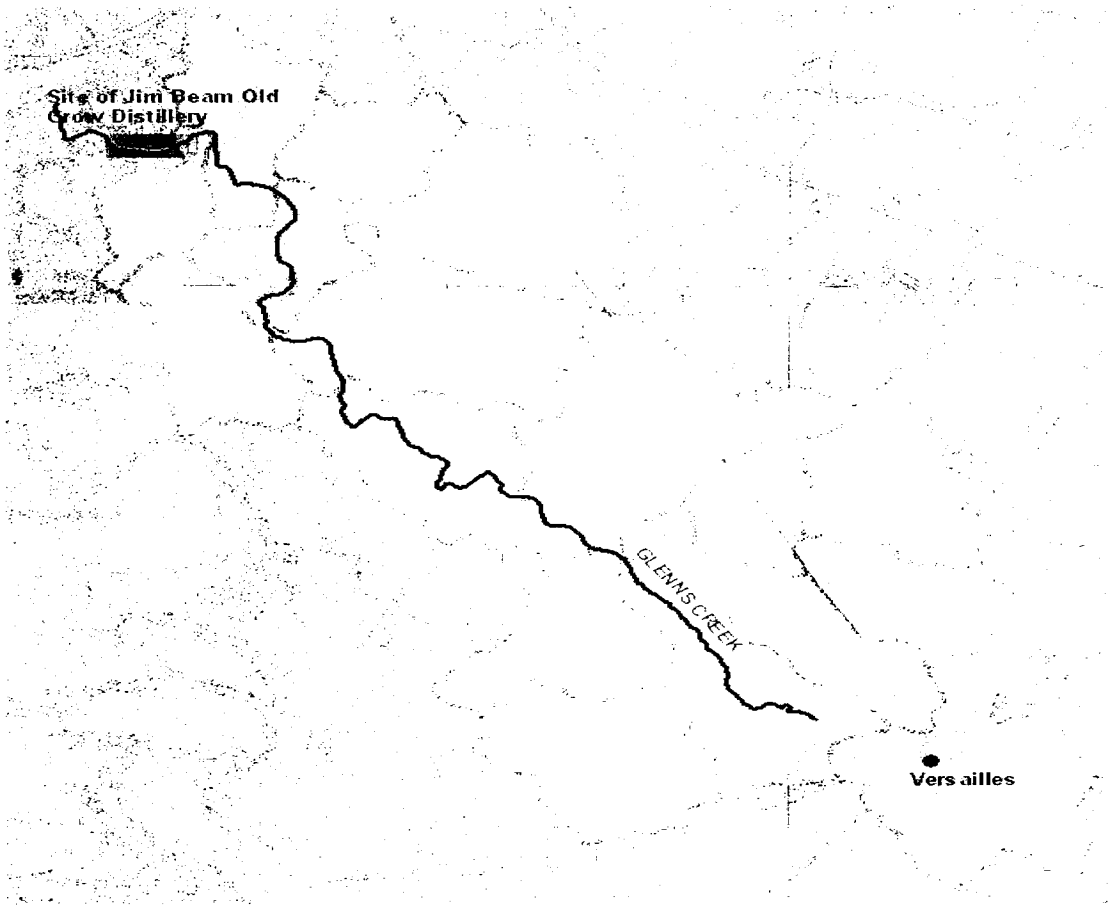


Figure 2.5: Glenns Creek Subwatersheds.

Rainfall estimates for selected recurrence interval events at were obtained from the National Weather Service - HDSC Precipitation Frequency Data Server, located at http://dipper.nws.noaa.gov/hdsc/pfds/. Estimates were based on rainfall data from the nearest gage, located northwest of the project site at Frankfort, KY (38.200 N, 84.873 W). The HEC-HMS model predicted a 100-year discharge of 17,370 cfs at the project site. This estimate was similar to the discharge listed in the FIS report, and further allows the evaluation of the effects of changes in landuse on peak discharges in the watershed. Therefore, the discharges predicted

from the SCS method were selected for use in the hydraulic analysis. The results of the hydrolgoic analysis using HEC-HMS are listed in Table 2.2.

Table 2.2: Peak Discharge Estimates for Glenns Creek.

Recurrence Interval (YR)	Discharge (cfs)
2	3,060
5	5,720
10	7,960
100 (2006 landuse)	17,370
100 (1937 landuse)	16,850

2.4 HYDRAULIC ANALYSIS

J.E. Spurrier Land Surveying performed a field survey in June 2008 to collect cross-sectional and structural data for Glenns Creek, near the Jim Beam Old Crow Distillery. Elevations beyond the extents of the surveyed cross-sections were estimated based on ten-foot contour data. The model created for this study extends from approximately 1,200 feet upstream of the driving bridge at the Old Crow Distillery downstream to approximately 1.64 miles upstream of the confluence with the Kentucky River.

HEC-RAS, a widely distributed and well documented software package developed by the U.S. Army Corps of Engineers, was used to perform the hydraulic modeling. A steady-state model was constructed using field survey data supplemented with best available contour data beyond the extents of the survey. Obstructions were placed in the model to reflect the location of warehouses near the streams channel. Ineffective flow areas were placed on cross-sections to reflect areas of little or no conveyance, such as between obstructions and near bridge expansions and contractions. There are three bridges present in the study reach, one vehicle bridge near the upstream end of the Old Crow site, and two abandoned railroad bridges located downstream. Two inline structures were also present and reflected in the model. A low-flow structure exists upstream of the most downstream railroad bridge. A low-head dam is located on the Old Crow site and serves to maintain a pool during low-flow conditions. During some smaller storm events (2-year, 5-year), this dam serves as a control point. A low-flow structure is also present upstream of the driving bridge. A detailed survey of this structure was not obtained, but the rock outcrop immediately downstream of this structure was captured and included in the model. Figure 2.6 shows the locations of surveyed cross sections used in the hydraulic analysis of the project site.

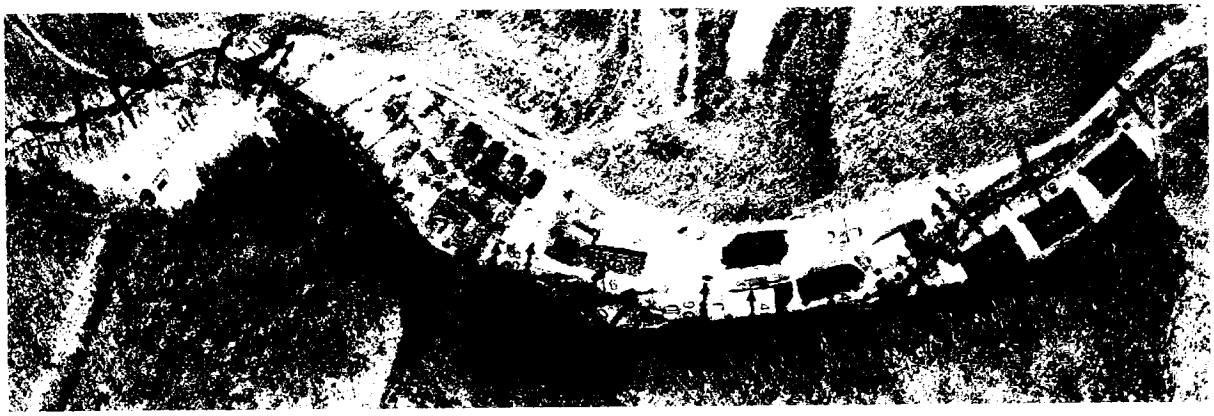


Figure 2.6: Hydraulic Model Cross Section Locations.

Normal depth was used as the downstream boundary condition for most model runs. It is known that for some events, the Kentucky River will have a backwater effect on water surface profiles through the project site. For the 100-year event labeled "FIS", the Kentucky River elevation of 510', from the Franklin County Flood Insurance Study (FEMA 2007), was used as the downstream boundary.

During the June survey, a high water mark from the April 4-5, 2008 storm event was recorded just upstream of the vehicle access bridge with an elevation of 514.7 feet. The hydraulic model predicted that a discharge of 5,000 cfs was necessary to reflect this high water mark. Based on this analysis and the results shown in Table 2.2, the April 4-5 event is just below the 5-year event.

Profiles incorporated into the model include the bankfull discharge estimate (1,600 cfs), the discharge from the April storm event (5,000 cfs), and the 10- and 100-year storm events predicted from the HEC-HMS model. The 100-year storm event was modeled with both a normal depth boundary condition and the 100-year Kentucky River boundary condition. Figure 2.7 shows these five water surface profiles for the study reach for existing conditions.

BEAM GLOBAL WINE AND SPIRITS, INC.
OLD CROW DISTILLERY
WOODFORD COUNTY, KENTUCKY

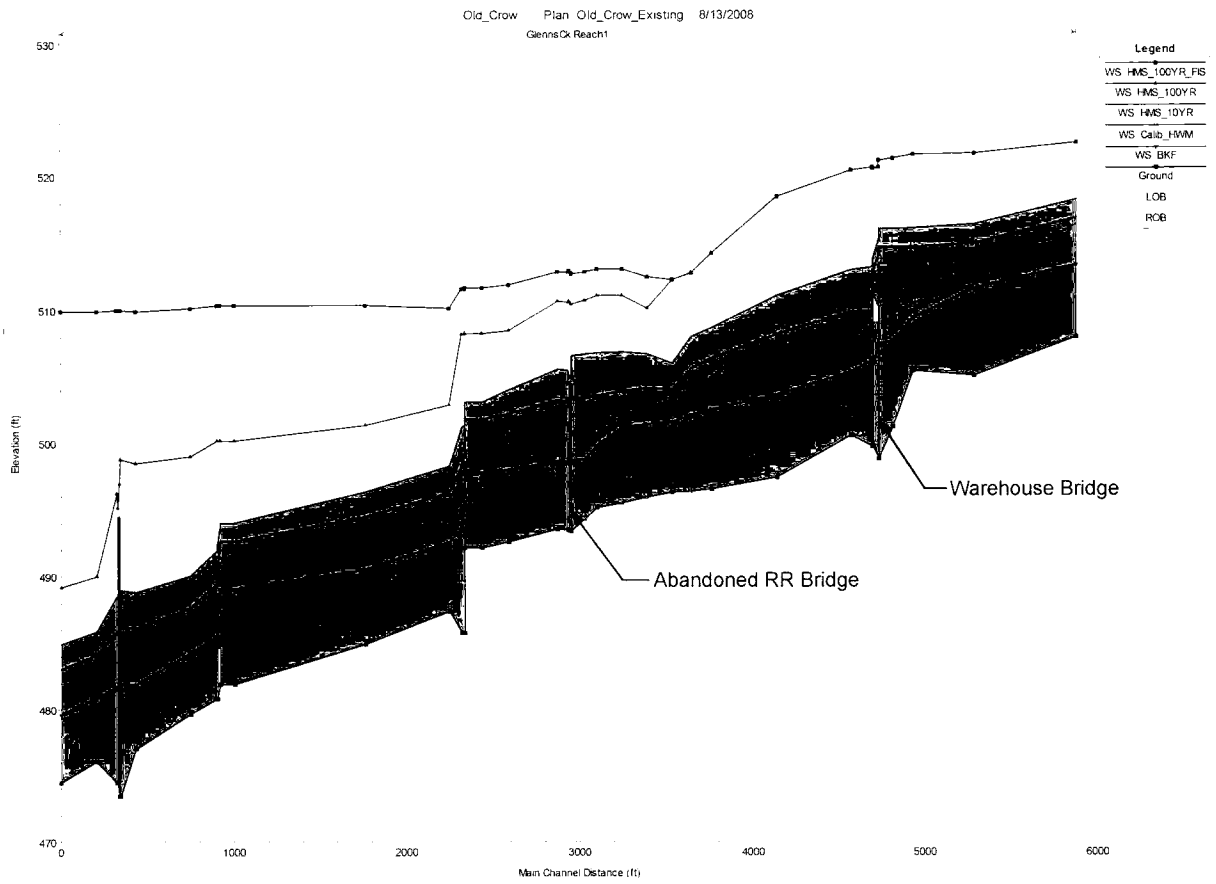


Figure 2.7: HEC-RAS Water Surface Profiles for Glenns Creek for existing conditions.

Water surface profiles near the Warehouse Bridge are of primary concern in this study. Three alternatives were evaluated to determine if existing stream crossings at the Old Crow Distillery site were increasing flood elevations. Three alternatives were evaluated for this purpose:

- Alternative 1: Removal of low-water crossing upstream of the Warehouse Bridge;
- Alternative 2: Removal of low-water crossing upstream of the Warehouse Bridge and the first abandoned railroad bridge located at downstream end of distillery property;
- Alternative 3: Removal of low-water crossing, the abandoned railroad bridge and the Warehouse Bridge.

The results of the analysis are presented in Table 2.3. The lowest reach of the hydraulic model of Glenns Creek at Section 0.0 is impacted by backwater from the Kentucky River for the 100-YR event. The Kentucky River the backwater elevation is used as the starting boundary condition (KY RIVER B.C.) for this event as indicated in Table 2.3. Normal depth is the appropriate boundary condition for the other three events. Figure 2.8 below shows the locations of all HEC-RAS sections that were used to model Glenns Creek in the vicinity of the Warehouse Bridge. Sections 5085 upstream of the bridge and Sections 4084 downstream of the bridge are the points of interest in this analysis.

Table 2.3: Water Surface Elevations for Selected Cross Sections.

Event	Existing Conditions WSE		Alternative 1 WSE		Alternative 2 WSE		Alternative 3 WSE	
	Section 5085	Section 4840	Section 5085	Section 4840	Section 5085	Section 4840	Section 5085	Section 4840
Bankfull	507.69	505.39	507.69	505.39	507.69	505.39	507.38	505.39
April 4-5	514.73	509.93	514.73	509.93	514.73	509.93	512.97	509.93
10-YR	516.14	513.07	516.14	513.07	516.14	513.07	514.03	513.07
100-YR (KY River B.C.)	521.35	520.48	521.35	520.48	521.35	520.48	520.93	520.48

The results show that removal of the low-water crossing (Alternative 1) has no effect on flood elevations. While its removal may be desirable to provide improved fish passage through the reach, it will not reduce flood risks.

Alternative 2, removal of the low-water crossing and first abandoned railroad bridge has no effect on water surface elevations in the vicinity of the Warehouse Bridge for the bankfull; April 4-5, 2008; 10-YR and 100 YR events.

Completely removing the Warehouse Bridge, low-water crossing and railroad bridge (Alternative 3) provides some flood elevation reductions immediately upstream of the bridge (ranging from 0.31 feet for the bankfull event to1.76 ft) with the greatest reduction for the April 4-5 event. The removal of the bridge has no impact downstream of the bridge at Section 4840, so it does not provide any effective flood relief for the Old Crow Distillery.

These results also indicate that modifications to the Warehouse Bridge geometry will not affect flood conditions. Measures such as removal of protrusions of steel members and low hanging pipe from the Warehouse Bridge to reduce debris accumulation appear to be the best alternative for reducing flood risks related to the bridge.

Figure 2.8: Cross Sections near Warehouse Bridge (2006 Imagery).

2.5 SEDIMENT TRANSPORT CAPACITY ANALYSIS

2.5.1 Sediment Capacity Model

Stantec used the FLOWSED/POWERSED tool in the Rivermorph software package to help analyze the sediment deposition problem in the study reach at the Old Crow Distillery. FLOWSED/POWERSED is a sediment capacity model that predicts the ability of a study reach to move the sediment load delivered from its watershed. The model predicts the annual amount of sediment moved by a stable supply reach that is not aggrading or degrading and establishes that quantity as a reference condition. The model then estimates the amount of sediment moved by an altered or impaired reach and compares that quantity to the reference quantity. The modeling results can be used to confirm field observations of aggradation, degradation, or

stability, as well as predict positive and negative consequences of alterations to the stream channel or changes in flow and sediment supply.

The FLOWSED component of the model uses records of discharge measurements from a nearby United States Geological Survey (USGS) stream gage to establish a flow-duration curve of mean daily discharge versus percent of time that flows are equaled or exceeded. Mean daily discharge values (Q_{mnd}) are divided by the bankfull discharge (Q_{bkf}) from the gage to establish a dimensionless flow-duration curve for the gage. The dimensionless flow-duration curve for the gage is converted to a dimensioned flow-duration curve for the project site by multiplying the ratios of Q_{mnd}/Q_{bkf} for the gage by the bankfull discharge for the project site. FLOWSED also converts established, dimensionless sediment rating curves of sediment transport rate versus stream discharge to dimensioned sediment rating curves for the supply reach. This is accomplished using field measurements or estimates of bankfull sediment transport rates in the supply reach. The dimensioned sediment rating curves and flow-duration curves are then used to estimate the total annual sediment load in tons per year transported by the supply reach and delivered to the study reach.

The POWERSED component of the model establishes a curve of unit stream power versus discharge for the supply and altered/impaired reaches. POWERSED uses the stream power versus discharge relationship and the sediment rating curve of sediment transport rate versus discharge for the supply reach to establish a relationship of sediment transport rate versus unit stream power for the supply reach. The relationship of sediment transport rate versus unit stream power for the supply reach is used with the curve of unit stream power versus discharge for the altered/impaired reach to predict the annual sediment transport capacity of the altered/impaired reach in tons per year.

2.5.2 Methodology

Stantec used the FLOWSED/POWERSED model to determine if a change in slope or cross-sectional dimensions of the channel just upstream of the bridge would increase the sediment transport capacity of the impaired reach at the Old Crow Distillery. Figure 1.7 below shows the locations of the supply and study cross-sections used in the model. Discharge records from USGS Gage 03289000, located on the South Elkhorn Creek (near Fort Spring in Fayette County, Kentucky), were used to develop a flow-duration curve for the model. Stantec used an estimation of bankfull discharge at the gage from a recent regional curve study published by the University of Louisville and the Kentucky Division of Water (Parola et al. 2007). Measurements of bankfull bedload and suspended sediment were beyond the scope of work for this project; however, assumed values of bankfull bedload (1.9 lb/s) and suspended sediment (100 mg/L) were appropriate for this qualitative analysis. The Good/Fair Pagosa dimensionless sediment

rating curves for bedload and suspended sediment published by Dave Rosgen (Rosgen 2006, 2006b) were used to develop the sediment rating curve for the supply reach.

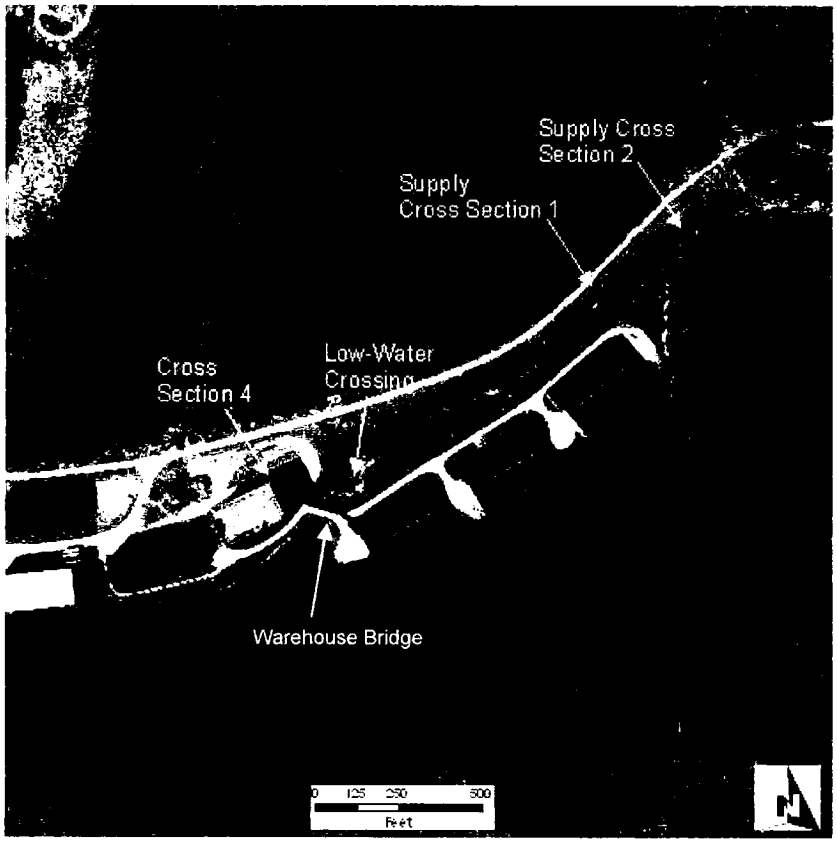


Figure 2.9: Location of Supply and Study Sections in FLOWSED/POWERSED Analysis.

2.5.3 Results

Stantec used FLOWSED/POWERSED to compare the sediment transport capacity of two supply cross-sections to the existing impaired cross-section (Cross Section 4), located just upstream of the bridge. As anticipated, the modeling results indicate that the stable supply cross-sections transport more sediment than the impaired cross-section, which corroborates field observations of excess sediment deposition just upstream of the low-water crossing.

Modeling results are summarized in Table 2.4 and complete results for each analysis are provided in Appendix B.

Table 2.4: FLOWSED/POWERSED Model Results.

Supply Reach Cross Section	Impaired Reach Cross Section	Supply Reach Slope (ft/ft)	Impaired Reach Slope (ft/ft)	Bankfull Discharge (cfs)	Supply Reach Total Transport (tons)	Impaired Reach Total Transport (tons)
Supply Cross Section 1	Existing Cross Section 4	0.0041	0.0002	1,327	1,973	634
Supply Cross Section 2	Existing Cross Section 4	0.0041	0.0002	1,413	1,778	634
Supply Cross Section 1	Proposed Cross Section 4	0.0041	0.0002	1,327	1,971	634
Supply Cross Section 2	Proposed Cross Section 4	0.0041	0.0002	1,413	1,778	634
Supply Cross Section 1	Existing Cross Section 4	0.0041	0.0035	1,327	1,973	1,983
Supply Cross Section 2	Existing Cross Section 4	0.0041	0.0039	1,413	1,778	1,709

Sediment transport capacity can be increased in a channel by either decreasing the width to depth ratio or increasing slope to increase stream power. The existing configuration of Cross Section 4 was altered in the model to decrease the width to depth ratio from 18 to 10. The new cross-section with a width to depth ratio of 10 was established as Proposed Cross Section 4. Figure 2.10 is a graph of the existing Cross Section 4 overlaid with Proposed Cross Section 4.

BEAM GLOBAL WINE AND SPIRITS, INC.
OLD CROW DISTILLERY
WOODFORD COUNTY, KENTUCKY

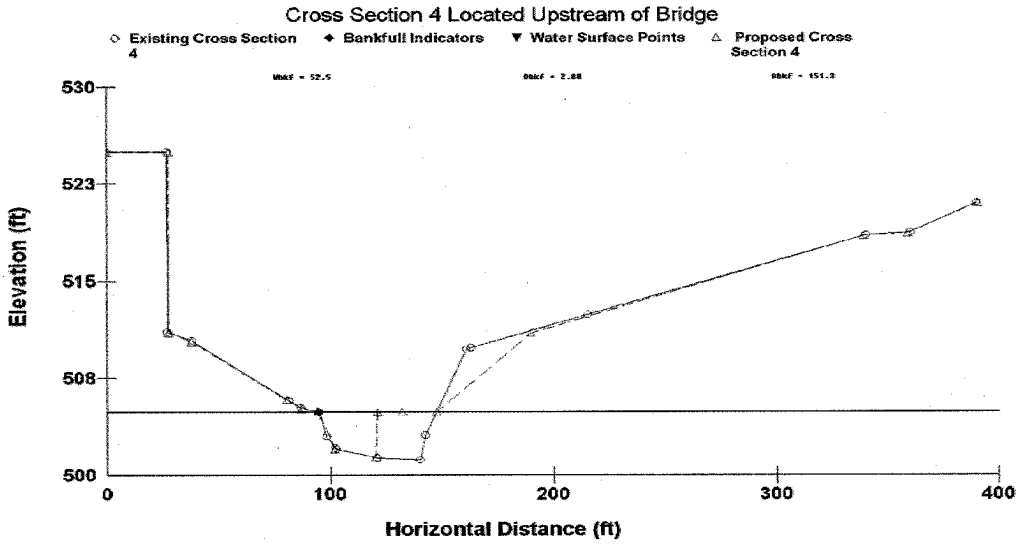


Figure 2.10: Cross Section 4 Existing and Proposed Configurations.

FLOWSED/POWERSED was used to compare the sediment transport capacity of the supply cross-sections (Cross Sections 1 and 2) and Proposed Cross Section 4. The existing slope of 0.0002 ft/ft just upstream of the bridge was used in the analysis. The results indicate that changing the current configuration of the impaired reach just upstream of the bridge to decrease the width to depth ratio will not result in an increase in sediment transport capacity for the reach. The impacts of bridge overtopping on water surface slopes is the controlling factor for sediment transport through the reach.

FLOWSED/POWERSED was then used to compare the sediment transport capacity of the supply cross-sections to the impaired reach using the existing configuration of Cross Section 4. In this analysis, multiple runs for the model were performed by increasing the slope for the impaired reach until the sediment transport capacity for the study reach equaled the sediment transport capacity of the supply reach. For the model using Cross Section 1 as the supply cross-section, the slope for the impaired reach that increased sediment transport capacity to that of the supply reach was 0.0035 ft/ft. For the model using Cross Section 2 as the supply cross-section, the slope for the impaired reach that increased sediment transport capacity to that of the supply reach was 0.0039 ft/ft. The results indicate that the nearly flat water-surface slope when the bridge is overtopped reduces the sediment transport capacity through the reach to about 1/3 the sediment supply, resulting in sediment deposition through the reach.

3.0 Conceptual Mitigation Plan

The conceptual plan for the mitigation of the impacted reach is presented in the plans provided in Appendix C. The plan includes stream restoration and enhancement along an 1,800 LF of stream on the Old Crow Distillery property: approximately 1,400 LF in the vicinity of the reach impacted by maintenance activities and approximately 350 LF upstream and 50 LF downstream of the abandoned railroad bridge.

The goals of the mitigation plan are:

- To improve aquatic habitat by:
    - Re-establishing riffle pool complex along the reach;
    - Restoring cobble substrate;
    - Shading the stream to reduce water temperature and raise dissolved oxygen levels;
    - Using structures that both protect stream banks, improve water quality, provide refuge for fish and allow fish passage; and
    - Providing a source of forest litter for the proliferation of macroinvertebrates in the stream.
- To improve riparian habitat by planting native tree(s), understory and ground cover that
    - Provides food and shelter for wildlife;
    - Supports a diverse and self-sustaining wildlife community.

Glenns Creek was divided into two restoration reaches within the boundaries of the Old Crow Distillery property. These reaches were selected because they have the greatest potential of providing a total of 1,800 linear feet of stream mitigation on site. Reach 1 is a 1,400 LF reach that includes the impact reach from the downstream extent of the stream impacts to a point 1,100 feet upstream of the Warehouse Bridge. Reach 2 extends from a point approximately 50 feet downstream of the abandoned railroad bridge to a point approximately 350 feet upstream of the bridge face. The total length of Restoration Reach 2 is 400 LF. The extent of Restoration Reaches 1 and 2 are shown in the profile on Sheet 2 of Appendix C.

BEAM GLOBAL WINE AND SPIRITS, INC.
OLD CROW DISTILLERY
WOODFORD COUNTY, KENTUCKY

The plan consists of the removal of the low-water crossing immediately upstream of the distillery bridge and installation of cross vanes upstream and downstream of the distillery bridge to reduce stress on stream banks, direct flow toward the center of the bridge opening away from its embankments, to maintain the bankfull channel and to provide effective fish passage through the reach. J-hook vane structures will be constructed in the bend upstream of the abandoned railroad bridge to reduce bank stresses and maintain pools in the bend.

Riparian planting zones are included in the plan to enhance existing riparian vegetation and to establish riparian vegetation in areas where it does not currently exist. The riparian vegetation will provide habitat for wildlife along the stream corridor and will improve aquatic habitat by providing shade to cool the stream and detritus to support the macro invertebrate community. The riparian vegetation will also help stabilize stream banks within the reach.

Imbricated Stone Toe Structures will be used to reconstruct eroded banks that may be out of the effective reach of cross vanes and j-hook vanes.

The stream will be designed as a B3/1c stream type. Bankfull dimensions of riffle sections for the design are given in Table 3.1 below.

Table 3.1: Bankfull Parameters for Design of Stream Restoration Reaches.

Bankfull Slope	0.006 ft/ft
Bankfull Depth (Average)	4.4 ft
Bankfull Depth (Maximum)	5.2 ft
Bankfull Area	215 sq. ft.
Bankfull Width	48 ft
w/D Ratio	18
Entrenchment Ratio	1.6 to 2.2

The proposed riffle cross section is shown in Figure 3.1 below. The conceptual plan showing the proposed location of structures, bank stabilization features and planting zones is shown in Appendix C.

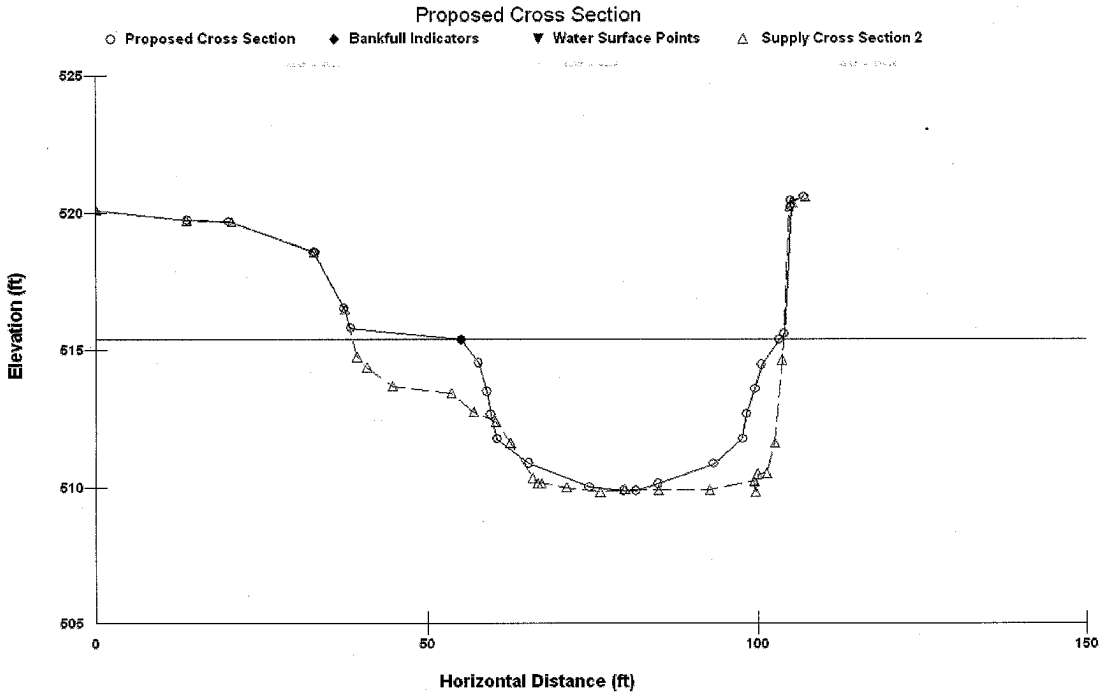


Figure 3.1: Existing and Proposed Riffle Cross Section.

The conceptual plan also includes the following components:

- Removal of protrusions from the Warehouse Bridge
- Raise the right descending downstream of the bridge to promote sediment transport
- Remove concrete remnants and abandoned pipes in stream
- Remove abandoned piers from the stream

Since the stream restoration will have essentially no impact on flood elevations or frequency, it is recommended that floodproofing of warehouses and other structures on the site be included in the long term plan for the site.

4.0 Summary

A watershed assessment and hydrologic, hydraulic and sediment transport analysis was completed on Glenns Creek at the Old Crow Distillery in Woodford County, Kentucky. The watershed assessment included the mapping of the watershed in GIS including coverages with aerial photography from 1937, 1949, 1957, 1969, 1980 and 2006. The mapping supported field assessments, hydrologic modeling of the watershed and sediment transport models. The field assessment identified potential sediment sources, characterized the stream and located stable sections for use in the FLOWSED/POWERSED model for sediment transport.

Land use maps were developed based on the 1937 and 2006 aerial photography. Data from these maps were used in the HEC-HMS hydrologic model to assess the impacts of watershed development on stormwater discharges at the Old Crow Distillery. The model results showed that development upstream of the distillery has not significantly increased stream flow volumes and rates at the distillery site.

A stream assessment was conducted at the project site. The stream is classified as B3/1c and F3/1 through the project reach. The existing and proposed bankfull parameters are summarized in Table 4.1. The bankfull slope is 0.006 ft/ft through the reach.

Given the encroachments on the floodplain in the project area, there are no practical means of providing additional flood relief along Glenns Creek. The removal of the abandoned railroad bridge and hypothetical removal of the Warehouse Bridge were considered. While some local relief was observed in the immediate vicinity of these crossing, their removal provided virtually no reductions in flood elevations for the distillery site. The hydrologic model showed that water surface slopes near the Warehouse Bridge are nearly level when the bridge is overtopped but that adequate slopes are maintained as long as flow goes under the bridge.

The FLOWSED/POWERSED model for sediment transport showed that transport capacity through the Warehouse Bridge and abandoned railroad bridge is adequate as long as the bridges are not overtopped. When the Warehouse Bridge is overtopped its sediment transport capacity is only 1/3 of the sediment load delivered to the bridge.

Table 4.1: Summary of Existing and Proposed Bankfull Parameters of Glenns Creek throughout the Old Crow Distillery Property.

EXISTING STREAM DATA	
Drainage Area (sq. mi.)	33
Bedslope (%)	0.50
Stream Type	F3/1
Pfankuch Rating	76
Particle Classification	cobble/bedrock
Valley Type	II and VI
CROSS SECTION 1	
D_{bkf} (ft)	3.12
W_{bkf} (ft)	69.23
A_{bkf} (ft^2)	216
D_{max} (ft)	4.74
Entrenchment Ratio	1.72
w/D	22.19
Stream Type	B3c
Pfankuch Stability	Fair
CROSS SECTION 2	
D_{bkf} (ft)	3.4
W_{bkf} (ft)	64.12
A_{bkf} (ft^2)	218.3
D_{max} (ft)	4.89
Entrenchment Ratio	1.3
w/D	18.86
Stream Type	F3
Pfankuck Stability	Good

PROPOSED DESIGN PARAMETERS	
S_{bkf} (ft/ft)	0.006
D_{bkf} (ft)	4.4
D_{max} (ft)	5.2
A_{bkf} (ft^2)	215
W_{bkf} (ft)	48
w/D	18
Entrenchment Ratio	1.6 to 2.2
Restoration Type	Priority II
Design Stream Type	B3/1c

A conceptual mitigation plan was developed for two restoration reaches on the distillery site. Restoration Reach 1 is 1,400 LF extending from the downstream extent of the impacted reach approximately 300 ft downstream of the Warehouse Bridge to a point 1,100 feet upstream of the

bridge. Restoration Reach 2 extends from a point approximately 50 downstream of the abandoned railroad bridge upstream through the existing bend to a point approximately 350 ft upstream of the bridge. The design dimensions for the restored creek section are shown in Table 4.1 above.

The conceptual plan for Restoration Reach 1 includes the removal of the low-water crossing upstream of Warehouse Bridge; construction of a series of cross vanes and step pools to protect stream banks, maintain pools, step the stream down under the bridge and provide fish passage through the reach. The cross vanes will also help maintain an efficient channel through the reach by promoting the deposition of bars along the banks that will serve as bankfull benches. The banks below bankfull will be seeded with native species, protected with erosion control fabric and live staked to stabilize the banks and shade the stream. Imbricated stone toe structures will be used to protect eroded banks that are out of the effective reach of the cross vane structures.

Material placed on the floodplain and banks during maintenance activities and subsequently deposited on rock bars will be used as backfill material for structures. This material will also be used to construct bankfull benches along the bank upstream of structures. This will enhance the formation of benches that are normally induced by the construction of cross vanes and j-hooks and contribute to the sediment transport capacity of the reach.

The conceptual plan for Restoration Reach 2 includes the installation of J-hook vanes upstream of the bridge to stabilize the outside bend and promote sediment transport. The outer cells in the bridge opening will be filled up to the bankfull elevation and a bankfull bench will be extended approximately 50 feet downstream of the bridge to the existing retaining wall. Imbricated stone toe structures will be used to protect the slope of the bankfull bench.

The conceptual mitigation plan is provided in Appendix C of this report. It provides the basis of a comprehensive plan to restore the integrity of the aquatic and riparian habitat through the restoration reaches and effectively mitigate the impacted reach.

5.0 References

Eco-Tech Consultants, Inc. 2008. Glenns Creek Geomorphic Assessment at the Old Crow Distillery in Woodford County, Kentucky (KDOW AI No. 40205). Frankfort, Kentucky.

Federal Emergency Management Agency (FEMA), 1977, Flood Insurance Study: Woodford County, Kentucky, Unincorporated Areas, Effective Date: December 1977, 18 p.

Federal Emergency Management Agency (FEMA), 2007, Flood Insurance Study: Franklin County, Kentucky, and Unincorporated Areas, Effective Date: September 28, 2007, 29 p.

Hodgkins, G.A. and Martin, G.R., 2003, Estimating the Magnitude of Peak Flows for Streams in Kentucky for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 03-4180, 73 p.

Parola Jr., Arthur C., et al. 2007. Geomorphic Characteristics of Streams in the Bluegrass Physiographic Region of Kentucky. Co-published by the University of Louisville Stream Institute and the Kentucky Division of Water.

Rosgen, Dave. 2006. Watershed Assessment of River Stability and Sediment Supply (WARSSS). Fort Collins: Wildland Hydrology.

Rosgen, Dave. 2006b. FLOWSED/POWERSED – Prediction Models for Suspended and Bedload Transport. Proceedings of the Eigth Federal Interagency Sedimentation Conference (8th FISC). April 2-6, 2006. Reno, NV.

6.0 Appendix A. Metadata References

All imagery was found at www.kygeonet.ky.gov from the Kentucky Geographic Network.

6.1 WOODFORD COUNTY AERIAL

Heart of the Bluegrass; Woodford County – 2006 Orthophoto – MrSID (2m),

Published: July 11, 2007

Accessed: June 2008

Digital Download from www.kygeonet.ky.gov

6.2 FRANKLIN COUNTY AERIAL

Frankfort 2006 Homeland Security Digital Ortho Imagery

Published: September 12, 2006

Accessed: June 2008

Digital Download from www.kygeonet.ky.gov

6.3 KENTUCKY MAJOR RIVERS

Title: Major Rivers of Kentucky

Published: September 5, 2006

Accessed: June 2008

Digital Download: www.kygeonet.ky.gov

6.4 KENTUCKY STATE ROADS

Publication_Date: September 5, 2006

Title: KYTC Local Roads

Published: September 5, 2006

Accessed: June 2008

Digital Download: www.kygeonet.ky.gov

6.5 PROJECT DIGITAL ELEVATION MODELS (DEMs)

Kentucky Single Zone 30ft DEM

Published: September 2000

Accessed: June 2008

Digital Download: www.kygeonet.ky.gov

6.6 PROJECT DIGITAL RASTER GRAPHICS (DRGs)

7.5 Minute Topographic Maps of Kentucky (DRGs)

Published: 1998

Accessed: June 2008

Digital Download: www.kygeonet.ky.gov

6.7 HISTORICAL AERIAL PHOTOS

Historical Aerial Photography was scanned in at a resolution of 200 DPI and imputed into ArcView on June 5-6, 2008. All imagery was copied from the Woodford County Soil Conservation District's archived at the Agricultural Resources Building 180 Beasley Road Versailles, KY on June 4, 2008.

Imagery:

Date Flown: 1937 Scale: 4 in = 1 mile

Date Flown: 1949 Scale: 4 in = 1 mile

Date Flown: 1957 Scale: 4 in = 1 mile

Date Flown: 1969 Scale: 4 in = 1 mile

Date Flown: 1980 Scale: 3.17 in = 1 mile

7.0 Appendix B. FLOWSED/POWERSED Results

Worksheet 5-12a. Bedload and suspended sand bed-material load transport prediction for the upstream reach, using the POWERSED model.

Stream: **Glenn's Creek**							Location: **Supply Cross Section 1**										Date: **07/14/08**
Observers: **EB, BF**							Stream Type:			Valley Type:			Gage Station #: **03289000**				
Flow-duration curve		**Calculate**	**Hydraulic geometry**				**Measure**	**Calculate**									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.00%	0.00										0%				0.00	0.00	0.00
90.00%	4.31	2.15	2.00	8.96	0.22	1.07	0.0041	0.06	0.55	0.06	10%	36.50	0.00	0.04	0.00	1.46	1.46
80.00%	9.62	6.97	5.45	18.63	0.29	1.28	0.0041	0.07	1.78	0.10	10%	36.50	0.00	0.12	0.00	4.38	4.38
70.00%	15.92	12.77	9.16	27.63	0.33	1.38	0.0041	0.08	3.27	0.12	10%	36.50	0.00	0.22	0.00	8.03	8.03
60.00%	24.87	20.40	13.20	33.94	0.39	1.54	0.0041	0.10	5.22	0.15	10%	36.50	0.00	0.35	0.00	12.77	12.77
50.00%	37.47	31.17	17.94	38.62	0.46	1.73	0.0041	0.11	7.97	0.21	10%	36.50	0.00	0.54	0.00	19.71	19.71
40.00%	56.37	46.92	24.23	44.21	0.55	1.93	0.0041	0.13	12.00	0.27	10%	36.50	0.00	0.81	0.00	29.57	29.57
30.00%	87.53	71.95	32.59	49.07	0.66	2.20	0.0041	0.16	18.41	0.38	10%	36.50	0.00	1.25	0.00	45.63	45.63
20.00%	134.61	111.07	42.59	49.76	0.86	2.60	0.0041	0.21	28.42	0.57	10%	36.50	0.00	1.98	0.00	72.27	72.27
10.00%	253.31	193.96	60.16	50.92	1.18	3.22	0.0041	0.29	49.62	0.97	10%	36.50	0.30	3.81	10.95	139.07	150.02
5.00%	416.11	334.71	84.58	52.43	1.61	3.96	0.0041	0.39	85.63	1.63	5%	18.25	3.11	8.80	56.76	160.60	217.36
4.00%	484.74	450.43	102.48	54.15	1.89	4.40	0.0041	0.46	115.24	2.13	1%	3.65	6.87	16.14	25.08	58.91	83.99
3.00%	575.59	530.17	114.27	55.66	2.05	4.64	0.0041	0.50	135.64	2.44	1%	3.65	10.20	23.75	37.23	86.69	123.92
2.00%	710.20	642.90	130.34	57.93	2.25	4.93	0.0041	0.55	164.48	2.84	1%	3.65	16.07	39.30	58.66	143.45	202.11
1.50%	860.07	785.14	149.72	60.78	2.46	5.24	0.0041	0.60	200.87	3.30	1%	1.83	25.40	69.34	46.36	126.55	172.91
1.00%	991.70	925.89	167.99	63.36	2.65	5.51	0.0041	0.65	236.88	3.74	1%	1.83	36.85	113.87	67.25	207.81	275.06
0.75%	1147.86	1069.78	185.77	65.63	2.83	5.76	0.0041	0.69	273.69	4.17	0%	0.91	50.98	178.68	46.52	163.05	209.57
0.50%	1376.31	1262.09	208.51	68.35	3.05	6.05	0.0041	0.74	322.89	4.72	0%	0.91	73.61	303.31	67.17	276.77	343.94
0.25%	1720.47	1548.39					0.0041				0%				0.00	0.00	0.00
										Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):					416.0	1556.7	1972.7

Worksheet 5-12a. Bedload and suspended sand bed-material load transport prediction for the upstream reach, using the POWERSED model.

Stream:	Glenn's Creek						Location: Supply Cross Section 2									Date: 07/14/08		
Observers:	EB, BF						Stream Type:			Valley Type:			Gage Station #: 03289000					
Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate										
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.00%	0.00										0%				0.00	0.00	0.00
90.00%	4.31	2.15	3.00	25.21	0.12	0.71	0.0041	0.03	0.55	0.02	10%	36.50	0.00	0.04	0.00	1.46	1.46
80.00%	9.62	6.97	6.54	30.71	0.21	1.04	0.0041	0.05	1.78	0.06	10%	36.50	0.00	0.12	0.00	4.38	4.38
70.00%	15.92	12.77	9.77	33.58	0.29	1.29	0.0041	0.07	3.27	0.10	10%	36.50	0.00	0.22	0.00	8.03	8.03
60.00%	24.87	20.40	13.06	33.98	0.38	1.55	0.0041	0.10	5.22	0.15	10%	36.50	0.00	0.35	0.00	12.77	12.77
50.00%	37.47	31.17	17.07	34.94	0.49	1.82	0.0041	0.12	7.97	0.23	10%	36.50	0.00	0.54	0.00	19.71	19.71
40.00%	56.37	46.92	22.18	36.26	0.61	2.11	0.0041	0.15	12.00	0.33	10%	36.50	0.00	0.81	0.00	29.57	29.57
30.00%	87.53	71.95	28.91	36.94	0.78	2.48	0.0041	0.20	18.41	0.50	10%	36.50	0.00	1.25	0.00	45.63	45.63
20.00%	134.61	111.07	37.94	37.83	1.00	2.93	0.0041	0.25	28.42	0.75	10%	36.50	0.00	1.97	0.00	71.91	71.91
10.00%	253.31	193.96	53.97	39.37	1.37	3.59	0.0041	0.34	49.62	1.26	10%	36.50	0.13	3.74	4.75	136.51	141.26
5.00%	416.11	334.71	76.57	41.25	1.86	4.37	0.0041	0.46	85.63	2.08	5%	18.25	2.59	8.38	47.27	152.94	200.21
4.00%	484.74	450.43	92.99	42.68	2.18	4.84	0.0041	0.53	115.24	2.70	1%	3.65	5.88	14.96	21.46	54.60	76.06
3.00%	575.59	530.17	105.20	45.42	2.32	5.04	0.0041	0.56	135.64	2.99	1%	3.65	8.77	21.70	32.01	79.21	111.22
2.00%	710.20	642.90	120.27	47.40	2.54	5.34	0.0041	0.62	164.48	3.47	1%	3.65	13.87	35.34	50.63	128.99	179.62
1.50%	860.07	785.14	138.15	49.48	2.79	5.68	0.0041	0.68	200.87	4.06	1%	1.83	22.03	61.50	40.20	112.24	152.44
1.00%	991.70	925.89	164.05	59.59	2.75	5.64	0.0041	0.67	236.88	3.98	1%	1.83	32.01	100.12	58.42	182.72	241.14
0.75%	1147.86	1069.78	181.02	61.24	2.96	5.91	0.0041	0.72	273.69	4.47	0%	0.91	44.28	156.18	40.41	142.51	182.92
0.50%	1376.31	1262.09	202.49	63.08	3.21	6.23	0.0041	0.78	322.89	5.12	0%	0.91	64.02	263.79	58.42	240.71	299.13
0.25%	1720.47	1548.39					0.0041				0%				0.00	0.00	0.00
											Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):				353.6	1423.9	1777.5

Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: **Glenn's Creek** Location: **Existing Cross Section 4 (Just Upstream Bridge)** Date: **07/14/08**

Observers: **EB, BF** Stream Type: Valley Type: Gage Station #: **03289000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.00%	0.00										0%				0.00	0.00	0.00
90.00%	4.31	2.15	7.65	27.29	0.28	0.28	0.0002	0.00	0.03	0.00	10%	36.50	0.00	0.04	0.00	1.46	1.46
80.00%	9.62	6.97	17.36	36.11	0.48	0.40	0.0002	0.01	0.09	0.00	10%	36.50	0.00	0.12	0.00	4.38	4.38
70.00%	15.92	12.77	25.81	39.25	0.66	0.49	0.0002	0.01	0.16	0.00	10%	36.50	0.00	0.22	0.00	8.03	8.03
60.00%	24.87	20.40	34.65	40.48	0.86	0.59	0.0002	0.01	0.25	0.01	10%	36.50	0.00	0.35	0.00	12.77	12.77
50.00%	37.47	31.17	45.40	41.93	1.08	0.69	0.0002	0.01	0.39	0.01	10%	36.50	0.00	0.54	0.00	19.71	19.71
40.00%	56.37	46.92	59.05	43.69	1.35	0.79	0.0002	0.02	0.59	0.01	10%	36.50	0.00	0.81	0.00	29.57	29.57
30.00%	87.53	71.95	77.72	45.56	1.71	0.93	0.0002	0.02	0.90	0.02	10%	36.50	0.00	1.24	0.00	45.26	45.26
20.00%	134.61	111.07	103.22	48.09	2.15	1.08	0.0002	0.03	1.39	0.03	10%	36.50	0.00	1.91	0.00	69.72	69.72
10.00%	253.31	193.96	149.86	52.65	2.85	1.29	0.0002	0.03	2.42	0.05	10%	36.50	0.00	3.33	0.00	121.55	121.55
5.00%	416.11	334.71	237.15	73.46	3.23	1.41	0.0002	0.04	4.18	0.06	5%	18.25	0.00	5.75	0.00	104.94	104.94
4.00%	484.74	450.43	297.17	82.77	3.59	1.52	0.0002	0.04	5.62	0.07	1%	3.65	0.00	7.73	0.00	28.21	28.21
3.00%	575.59	530.17	336.27	88.31	3.81	1.58	0.0002	0.05	6.62	0.07	1%	3.65	0.00	9.10	0.00	33.21	33.21
2.00%	710.20	642.90	389.09	95.29	4.08	1.65	0.0002	0.05	8.02	0.08	1%	3.65	0.00	11.04	0.00	40.30	40.30
1.50%	860.07	785.14	452.55	103.04	4.39	1.73	0.0002	0.05	9.80	0.10	1%	1.83	0.00	13.48	0.00	24.60	24.60
1.00%	991.70	925.89	512.55	109.87	4.67	1.81	0.0002	0.06	11.56	0.11	1%	1.83	0.00	15.90	0.00	29.02	29.02
0.75%	1147.86	1069.78	571.69	116.26	4.92	1.87	0.0002	0.06	13.35	0.11	0%	0.91	0.00	18.37	0.00	16.76	16.76
0.50%	1376.31	1262.09	684.59	142.90	4.79	1.84	0.0002	0.06	15.75	0.11	0%	0.91	0.00	21.67	0.00	19.77	19.77
0.25%	1720.47	1548.39	828.88	169.70	4.88	1.87	0.0002	0.06	19.32	0.11	0%	0.91	0.00	26.59	0.00	24.26	24.26

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	0.0	633.5	633.5
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	415.0	1566.0	1971.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-415.0	-922.5	-1337.5
Stability evaluation: Aggradation, Degradation or Stable:			

Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: **Glenn's Creek** Location: **Proposed Cross Section 4 Just Upstream Bridge** Date: **07/14/08**

Observers: **EB, BF** Stream Type: Valley Type: Gage Station #: **03289000**

Flow-duration curve		Calculate	Hydraulic geometry				Measure	Calculate									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.00%	0.00										0%				0.00	0.00	0.00
90.00%	4.31	2.15	6.60	18.55	0.36	0.32	0.0002	0.00	0.03	0.00	10%	36.50	0.00	0.04	0.00	1.46	1.46
80.00%	9.62	6.97	13.85	19.76	0.70	0.50	0.0002	0.01	0.09	0.00	10%	36.50	0.00	0.12	0.00	4.38	4.38
70.00%	15.92	12.77	20.39	20.62	0.99	0.63	0.0002	0.01	0.16	0.01	10%	36.50	0.00	0.22	0.00	8.03	8.03
60.00%	24.87	20.40	27.64	21.54	1.28	0.74	0.0002	0.01	0.25	0.01	10%	36.50	0.00	0.35	0.00	12.77	12.77
50.00%	37.47	31.17	36.54	22.62	1.62	0.85	0.0002	0.02	0.39	0.02	10%	36.50	0.00	0.54	0.00	19.71	19.71
40.00%	56.37	46.92	48.07	23.94	2.01	0.98	0.0002	0.02	0.59	0.02	10%	36.50	0.00	0.81	0.00	29.57	29.57
30.00%	87.53	71.95	64.34	25.69	2.50	1.12	0.0002	0.03	0.90	0.04	10%	36.50	0.00	1.24	0.00	45.26	45.26
20.00%	134.61	111.07	122.24	71.55	1.71	0.91	0.0002	0.02	1.39	0.02	10%	36.50	0.00	1.91	0.00	69.72	69.72
10.00%	253.31	193.96	181.67	84.00	2.16	1.07	0.0002	0.03	2.42	0.03	10%	36.50	0.00	3.33	0.00	121.55	121.55
5.00%	416.11	334.71	269.22	99.60	2.70	1.24	0.0002	0.03	4.18	0.04	5%	18.25	0.00	5.75	0.00	104.94	104.94
4.00%	484.74	450.43	334.07	109.73	3.04	1.35	0.0002	0.04	5.62	0.05	1%	3.65	0.00	7.73	0.00	28.21	28.21
3.00%	575.59	530.17	376.27	115.85	3.25	1.41	0.0002	0.04	6.62	0.06	1%	3.65	0.00	9.10	0.00	33.21	33.21
2.00%	710.20	642.90	433.27	123.64	3.50	1.48	0.0002	0.04	8.02	0.06	1%	3.65	0.00	11.04	0.00	40.30	40.30
1.50%	860.07	785.14	501.68	132.38	3.79	1.56	0.0002	0.05	9.80	0.07	1%	1.83	0.00	13.48	0.00	24.60	24.60
1.00%	991.70	925.89	566.35	140.15	4.04	1.63	0.0002	0.05	11.56	0.08	1%	1.83	0.00	15.90	0.00	29.02	29.02
0.75%	1147.86	1069.78	630.18	147.54	4.27	1.70	0.0002	0.05	13.35	0.09	0%	0.91	0.00	18.37	0.00	16.76	16.76
0.50%	1376.31	1262.09	718.74	160.24	4.49	1.76	0.0002	0.05	15.75	0.10	0%	0.91	0.00	21.67	0.00	19.77	19.77
0.25%	1720.47	1548.39	843.49	175.69	4.80	1.84	0.0002	0.06	19.32	0.11	0%	0.91	0.00	26.59	0.00	24.26	24.26

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	0.0	633.5	633.5
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	415.0	1556.0	1971.0
Difference in sediment transport capacity (tons/yr) (+ or -):	-415.0	-922.5	-1337.5
Stability evaluation: Aggradation, Degradation or Stable:			

Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream: **Glenn's Creek**							Location: **Existing Cross Section 4 with Increased Slope**									Date: **07/14/08**	
Observers: **EB, BF**							Stream Type:			Valley Type:		Gage Station #: **03289000**					
Flow-duration curve		**Calculate**	**Hydraulic geometry**				**Measure**	**Calculate**									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.00%	**0.00**										**0%**				**0.00**	**0.00**	**0.00**
90.00%	**4.31**	**2.15**	**2.93**	**21.69**	**0.14**	**0.72**	**0.0035**	**0.03**	**0.47**	**0.02**	**10%**	**36.50**	**0.00**	**0.04**	**0.00**	**1.46**	**1.46**
80.00%	**9.62**	**6.97**	**6.39**	**25.88**	**0.25**	**1.07**	**0.0035**	**0.05**	**1.52**	**0.06**	**10%**	**36.50**	**0.00**	**0.12**	**0.00**	**4.38**	**4.38**
70.00%	**15.92**	**12.77**	**9.71**	**29.37**	**0.33**	**1.30**	**0.0035**	**0.07**	**2.79**	**0.09**	**10%**	**36.50**	**0.00**	**0.22**	**0.00**	**8.03**	**8.03**
60.00%	**24.87**	**20.40**	**13.50**	**32.91**	**0.41**	**1.51**	**0.0035**	**0.09**	**4.46**	**0.14**	**10%**	**36.50**	**0.00**	**0.35**	**0.00**	**12.77**	**12.77**
50.00%	**37.47**	**31.17**	**18.17**	**36.69**	**0.50**	**1.71**	**0.0035**	**0.11**	**6.81**	**0.19**	**10%**	**36.50**	**0.00**	**0.54**	**0.00**	**19.71**	**19.71**
40.00%	**56.37**	**46.92**	**23.80**	**38.96**	**0.61**	**1.97**	**0.0035**	**0.13**	**10.25**	**0.26**	**10%**	**36.50**	**0.00**	**0.81**	**0.00**	**29.57**	**29.57**
30.00%	**87.53**	**71.95**	**31.11**	**39.99**	**0.78**	**2.31**	**0.0035**	**0.17**	**15.71**	**0.39**	**10%**	**36.50**	**0.00**	**1.25**	**0.00**	**45.63**	**45.63**
20.00%	**134.61**	**111.07**	**40.98**	**41.34**	**0.99**	**2.71**	**0.0035**	**0.21**	**24.26**	**0.59**	**10%**	**36.50**	**0.00**	**1.99**	**0.00**	**72.64**	**72.64**
10.00%	**253.31**	**193.96**	**58.60**	**43.63**	**1.34**	**3.31**	**0.0035**	**0.29**	**42.36**	**0.97**	**10%**	**36.50**	**0.30**	**3.81**	**10.95**	**139.07**	**150.02**
5.00%	**416.11**	**334.71**	**83.27**	**46.12**	**1.81**	**4.02**	**0.0035**	**0.39**	**73.10**	**1.58**	**5%**	**18.25**	**2.89**	**8.63**	**52.74**	**157.50**	**210.24**
4.00%	**484.74**	**450.43**	**101.13**	**47.89**	**2.11**	**4.45**	**0.0035**	**0.45**	**98.37**	**2.05**	**1%**	**3.65**	**6.26**	**15.46**	**22.85**	**56.43**	**79.28**
3.00%	**575.59**	**530.17**	**112.61**	**48.99**	**2.30**	**4.71**	**0.0035**	**0.49**	**115.79**	**2.36**	**1%**	**3.65**	**9.33**	**22.52**	**34.05**	**82.20**	**116.25**
2.00%	**710.20**	**642.90**	**127.99**	**50.43**	**2.54**	**5.02**	**0.0035**	**0.54**	**140.41**	**2.78**	**1%**	**3.65**	**15.21**	**37.72**	**55.52**	**137.68**	**193.20**
1.50%	**860.07**	**785.14**	**146.29**	**52.09**	**2.81**	**5.37**	**0.0035**	**0.60**	**171.47**	**3.29**	**1%**	**1.83**	**25.19**	**68.87**	**45.97**	**125.69**	**171.66**
1.00%	**991.70**	**925.89**	**172.67**	**61.72**	**2.80**	**5.36**	**0.0035**	**0.60**	**202.21**	**3.28**	**1%**	**1.83**	**25.01**	**80.67**	**45.64**	**147.22**	**192.86**
0.75%	**1147.86**	**1069.78**	**193.04**	**65.71**	**2.94**	**5.54**	**0.0035**	**0.63**	**233.64**	**3.56**	**0%**	**0.91**	**32.18**	**116.40**	**29.36**	**106.22**	**135.58**
0.50%	**1376.31**	**1262.09**	**219.12**	**70.43**	**3.11**	**5.76**	**0.0035**	**0.66**	**275.64**	**3.91**	**0%**	**0.91**	**42.42**	**177.20**	**38.71**	**161.70**	**200.41**
0.25%	**1720.47**	**1548.39**	**256.01**	**76.51**	**3.35**	**6.05**	**0.0035**	**0.71**	**338.17**	**4.42**	**0%**	**0.91**	**61.26**	**310.20**	**55.90**	**283.06**	**338.96**

Notes:

Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):	**391.7**	**1591.0**	**1982.7**
Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):	**415.0**	**1556.0**	**1971.0**
Difference in sediment transport capacity (tons/yr) (+ or -):	**-23.3**	**35.0**	**11.7**
Stability evaluation: Aggradation, Degradation or Stable:			

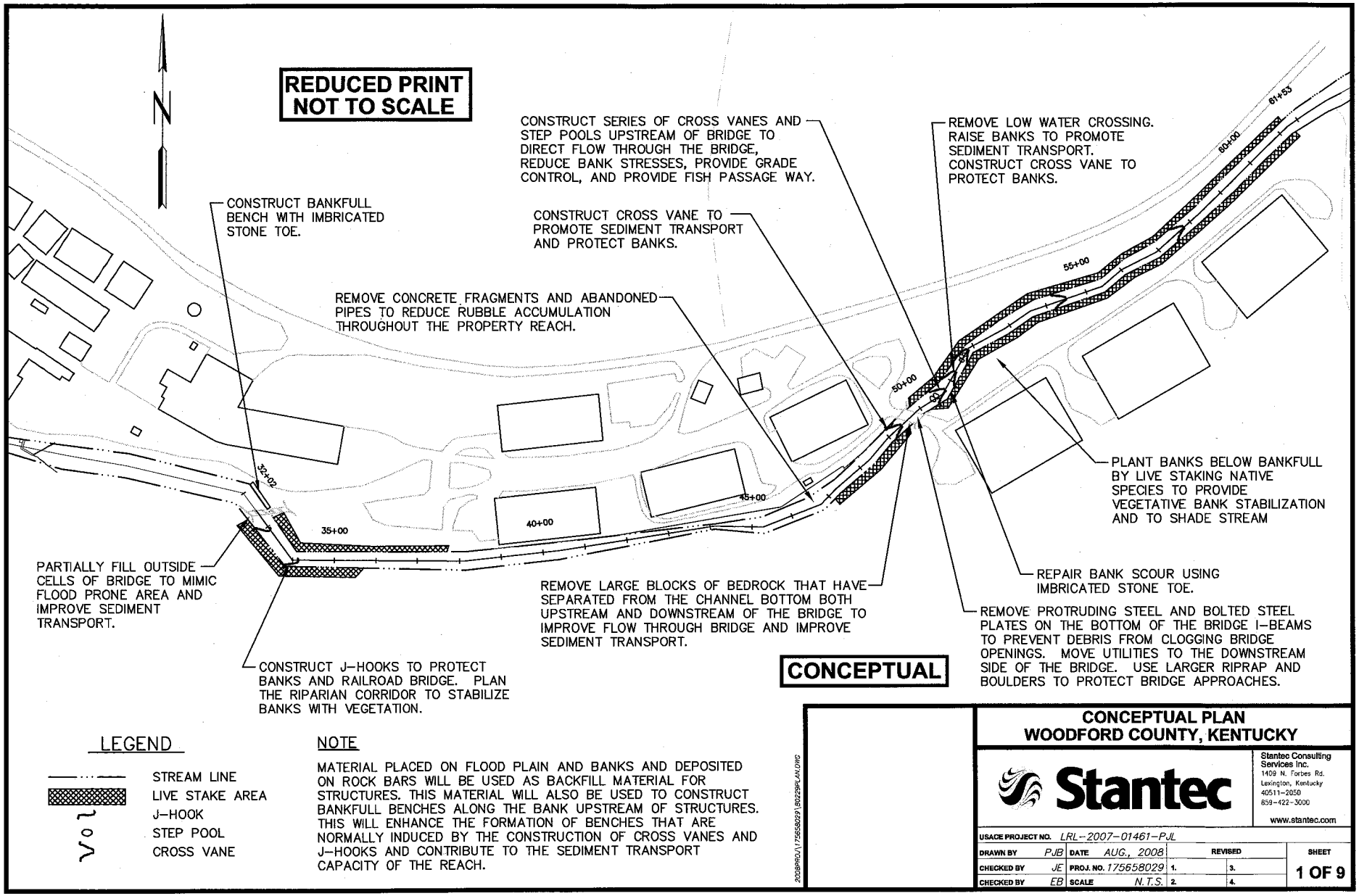
Worksheet 5-12b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Glenn's Creek						Location:	Existing Cross Section 4 with Increased Slope								Date:	07/14/08
Observers:	EB, BF						Stream Type:			Valley Type:			Gage Station #:	03289000			
Flow-duration curve		**Calculate**	**Hydraulic geometry**				**Measure**	**Calculate**									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid-ordinate stream-flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft^2)	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft^2)	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.00%	0.00										0%				0.00	0.00	0.00
90.00%	4.31	2.15	2.84	21.58	0.13	0.74	0.0039	0.03	0.52	0.02	10%	36.50	0.00	0.04	0.00	1.46	1.46
80.00%	9.62	6.97	6.16	25.62	0.24	1.11	0.0039	0.06	1.70	0.07	10%	36.50	0.00	0.12	0.00	4.38	4.38
70.00%	15.92	12.77	9.35	29.00	0.32	1.35	0.0039	0.08	3.11	0.11	10%	36.50	0.00	0.22	0.00	8.03	8.03
60.00%	24.87	20.40	12.98	32.43	0.40	1.57	0.0039	0.10	4.96	0.15	10%	36.50	0.00	0.35	0.00	12.77	12.77
50.00%	37.47	31.17	17.51	36.22	0.48	1.78	0.0039	0.12	7.59	0.21	10%	36.50	0.00	0.54	0.00	19.71	19.71
40.00%	56.37	46.92	22.99	38.85	0.59	2.03	0.0039	0.14	11.42	0.29	10%	36.50	0.00	0.81	0.00	29.57	29.57
30.00%	87.53	71.95	30.07	39.85	0.75	2.39	0.0039	0.18	17.51	0.44	10%	36.50	0.00	1.25	0.00	45.63	45.63
20.00%	134.61	111.07	39.58	41.15	0.96	2.80	0.0039	0.23	27.03	0.66	10%	36.50	0.00	1.95	0.00	71.18	71.18
10.00%	253.31	193.96	56.59	43.38	1.30	3.43	0.0039	0.31	47.20	1.09	10%	36.50	0.09	3.64	3.28	132.86	136.14
5.00%	416.11	334.71	80.40	45.83	1.75	4.16	0.0039	0.42	81.46	1.78	5%	18.25	1.68	7.67	30.66	139.98	170.64
4.00%	484.74	450.43	97.60	47.54	2.05	4.61	0.0039	0.49	109.62	2.31	1%	3.65	3.80	12.64	13.87	46.14	60.01
3.00%	575.59	530.17	108.66	48.61	2.24	4.88	0.0039	0.53	129.02	2.65	1%	3.65	5.62	17.26	20.51	63.00	83.51
2.00%	710.20	642.90	123.46	50.01	2.47	5.21	0.0039	0.59	156.46	3.13	1%	3.65	10.24	28.95	37.38	105.67	143.05
1.50%	860.07	785.14	141.07	51.62	2.73	5.56	0.0039	0.65	191.07	3.70	1%	1.83	17.06	50.30	31.13	91.80	122.93
1.00%	991.70	925.89	163.07	57.95	2.81	5.68	0.0039	0.67	225.32	3.89	1%	1.83	19.70	66.30	35.95	121.00	156.95
0.75%	1147.86	1069.78	185.15	64.20	2.88	5.78	0.0039	0.68	260.34	4.06	0%	0.91	22.03	83.79	20.10	76.46	96.56
0.50%	1376.31	1262.09	210.27	68.89	3.05	6.00	0.0039	0.72	307.14	4.46	0%	0.91	44.02	183.26	40.17	167.22	207.39
0.25%	1720.47	1548.39	245.70	74.86	3.28	6.30	0.0039	0.78	376.82	5.03	0%	0.91	61.30	310.12	55.94	282.98	338.92
Notes:											Total annual sediment yield (bedload and suspended sand bed-material load) (tons/yr):				289.0	1419.8	1708.8
											Upstream total annual sediment supply (tons/yr) (**Worksheet 5-12a**):				353.0	1423.0	1776.0
											Difference in sediment transport capacity (tons/yr) (+ or -):				-64.0	-3.2	-67.2
											Stability evaluation: Aggradation, Degradation or Stable:						

8.0 Appendix C. Conceptual Plan (Half-Size Prints)

Attachment 4 - Conceptual Stream Restoration Plan Figures

Completed by Stantec Consulting Services, Inc. (2008)



LEGEND

- STREAM LINE
- LIVE STAKE AREA
- J-HOOK
- STEP POOL
- CROSS VANE

NOTE

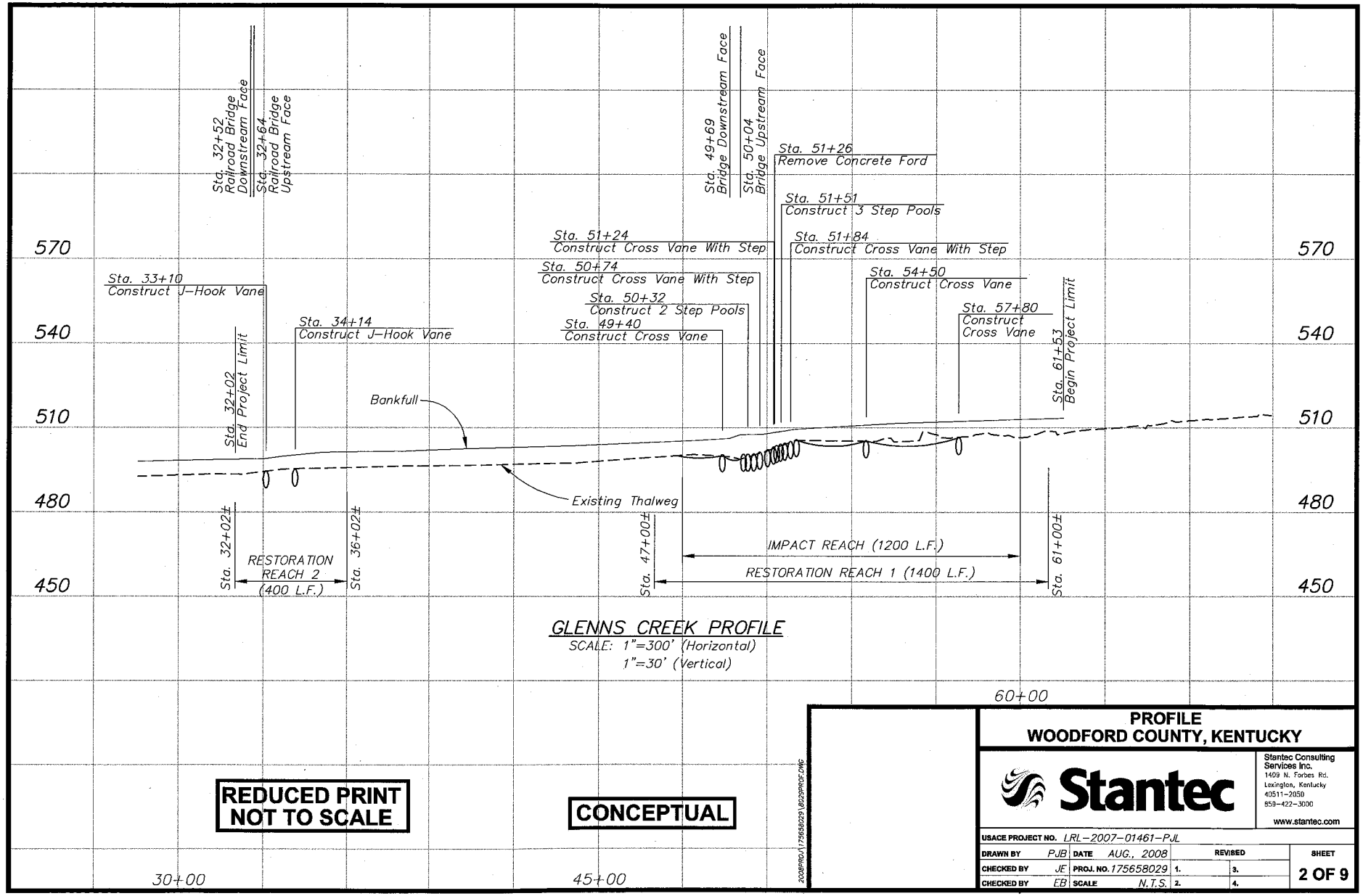
MATERIAL PLACED ON FLOOD PLAIN AND BANKS AND DEPOSITED ON ROCK BARS WILL BE USED AS BACKFILL MATERIAL FOR STRUCTURES. THIS MATERIAL WILL ALSO BE USED TO CONSTRUCT BANKFULL BENCHES ALONG THE BANK UPSTREAM OF STRUCTURES. THIS WILL ENHANCE THE FORMATION OF BENCHES THAT ARE NORMALLY INDUCED BY THE CONSTRUCTION OF CROSS VANES AND J-HOOKS AND CONTRIBUTE TO THE SEDIMENT TRANSPORT CAPACITY OF THE REACH.

2008960\1756580291\802290.ANDWG

CONCEPTUAL PLAN
WOODFORD COUNTY, KENTUCKY

Stantec
Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

USACE PROJECT NO.	LRL-2007-01461-PJL				
DRAWN BY	PJB	DATE	AUG., 2008	REVISED	SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1. 3.	1 OF 9
CHECKED BY	EB	SCALE	N.T.S.	2. 4.	



GLENNS CREEK PROFILE

SCALE: 1"=300' (Horizontal)
1"=30' (Vertical)

REDUCED PRINT
NOT TO SCALE

CONCEPTUAL

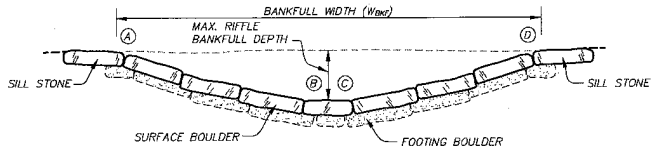
2008PROJ\175658029\B029PROF.DWG

PROFILE
WOODFORD COUNTY, KENTUCKY

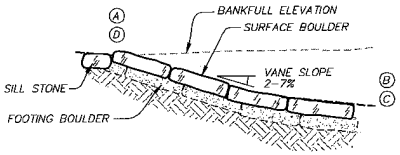
Stantec

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

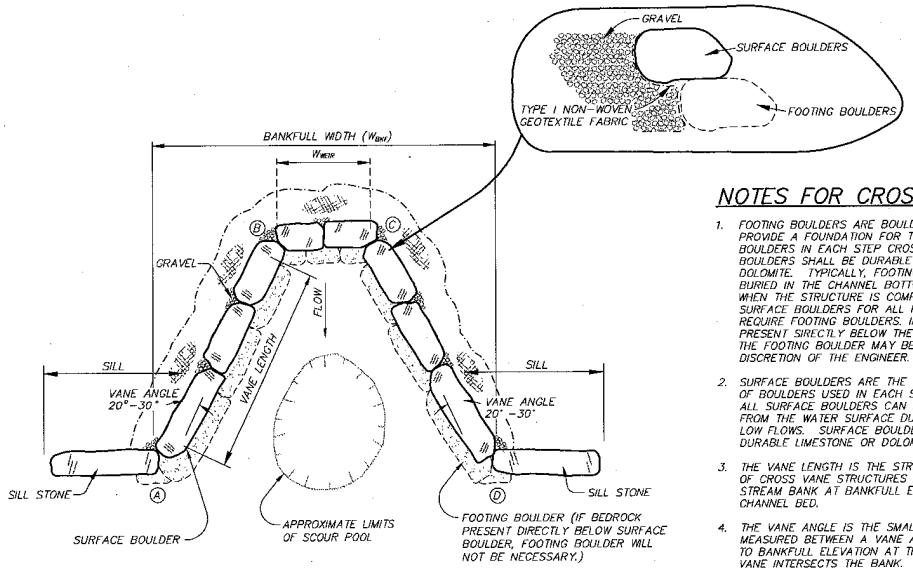
USACE PROJECT NO.	LRL-2007-01461-PJL				
DRAWN BY	PJB	DATE	AUG., 2008	REVISED	SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1. 3.	2 OF 9
CHECKED BY	EB	SCALE	N.T.S.	2. 4.	



CROSS VANE TYPICAL CROSS-SECTION



CROSS VANE LONGITUDINAL PROFILE



CROSS-VANE PLAN VIEW

NOTES FOR CROSS VANE INSTALLATION:

1. FOOTING BOULDERS ARE BOULDERS PLACED TO PROVIDE A FOUNDATION FOR THE SURFACE BOULDERS IN EACH STEP CROSS VANE. FOOTING BOULDERS SHALL BE DURABLE LIMESTONE OR DOLOMITE. TYPICALLY, FOOTING BOULDERS ARE BURIED IN THE CHANNEL BOTTOM AND NOT SEEN WHEN THE STRUCTURE IS COMPLETED. ALL SURFACE BOULDERS FOR ALL ROCK STRUCTURES REQUIRE FOOTING BOULDERS. IF BEDROCK IS PRESENT SIRECTLY BELOW THE SURFACE BOULDER, THE FOOTING BOULDER MAY BE OMITTED AT THE DISCRETION OF THE ENGINEER.
2. SURFACE BOULDERS ARE THE TOP MOST COURSE OF BOULDERS USED IN EACH STEP CROSS VANE. ALL SURFACE BOULDERS CAN BE SEEN PROTRUDING FROM THE WATER SURFACE DURING EXTREMELY LOW FLOWS. SURFACE BOULDERS SHALL BE DURABLE LIMESTONE OR DOLOMITE.
3. THE VANE LENGTH IS THE STRAIGHT LINE PORTION OF CROSS VANE STRUCTURES MEASURED FROM THE STREAM BANK AT BANKFULL ELEVATION TO THE CHANNEL BED.
4. THE VANE ANGLE IS THE SMALLEST ANGLE MEASURED BETWEEN A VANE AND A LINE TANGENT TO BANKFULL ELEVATION AT THE POINT WHERE THE VANE INTERSECTS THE BANK.
5. CONSTRUCT STEP CROSS VANE STRUCTURES BY FIRST SHAPING THE BANK TO THE GRADES SPECIFIED. NEXT EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, GEOTEXTILE FABRIC AND GRAVEL OVERLAY. PLACE FOOTING BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT AND THEN CHECK THE ELEVATIONS OF THE INVERTS. ONCE THE INVERTS HAVE BEEN ESTABLISHED THE REMAINDER OF THE FOOTING AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS. PLACE GEOTEXTILE FILTER FABRIC AT THE UPSTREAM FACE OF THE STRUCTURE AS SHOWN AND BACKFILL (OVERLAY) WITH GRAVEL. FILL THE VOIDS ON THE UPSTREAM SIDE OF SURFACE BOULDERS WITH GRAVEL. DO NOT LEAVE EXPOSED GEOTEXTILE FABRIC AND TRIM EXPOSED GEOTEXTILE FABRIC. ONCE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE GRAVEL SUBSTRATE AS REQUIRED. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
6. THE SURFACE OF CROSS, J-HOOK AND LOG VANES SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH ROCK TO FORM A TIGHT-FITTING SEAL.
7. CONTRACTOR SHALL USE AN EXCAVATOR WITH A HYDRAULIC THUMB TO CONSTRUCT HYDRAULIC STRUCTURES.

DETAIL – CROSS VANE
SCALE: NOT TO SCALE
CROSSVANE.DWG

REDUCED PRINT NOT TO SCALE

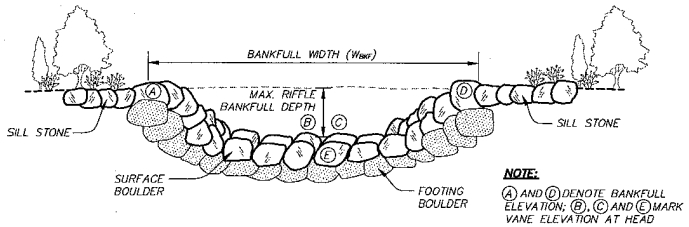
CONCEPTUAL

2008PROJ\175658029\CROSSVANE.DWG

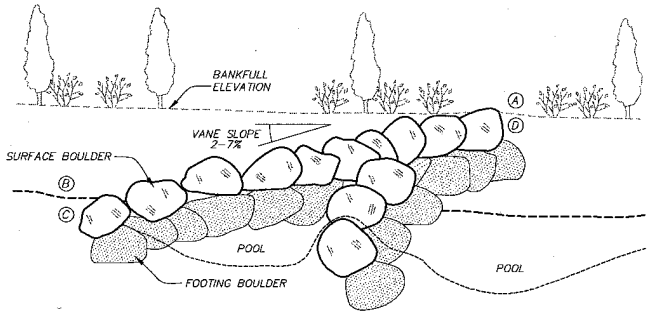
DETAILS
WOODFORD COUNTY, KENTUCKY

Stantec
Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

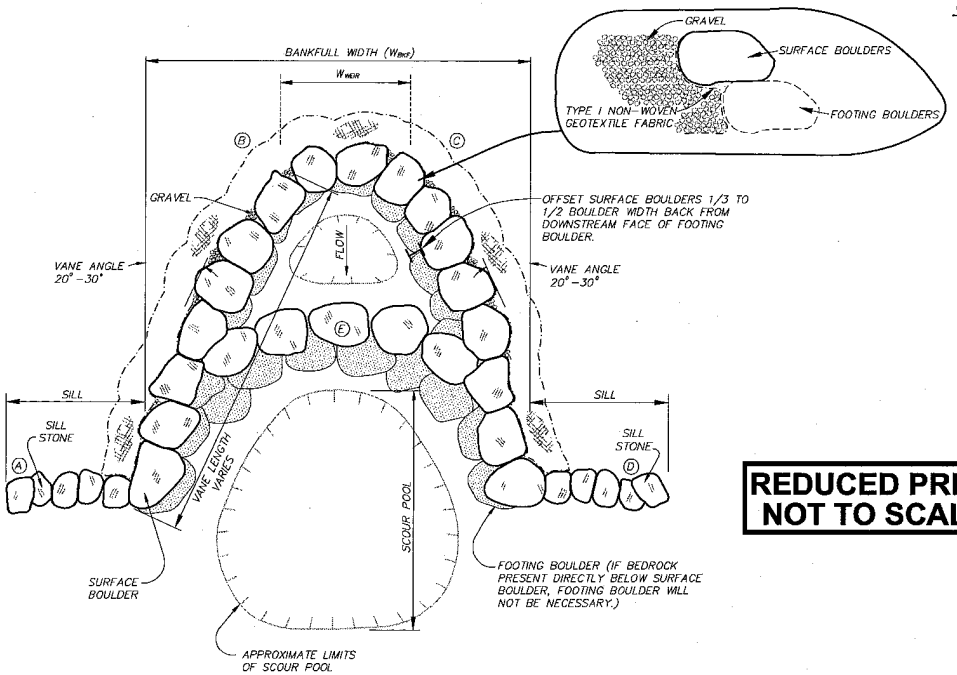
USACE PROJECT NO.	LRL-2007-01461-PJL				
DRAWN BY	PJB	DATE	AUG., 2008	REVISED	SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1. 3.	3 OF 9
CHECKED BY	EB	SCALE	AS SHOWN	2. 4.	



CROSS VANE TYPICAL CROSS-SECTION



CROSS VANE LONGITUDINAL PROFILE



CROSS-VANE PLAN VIEW

NOTES FOR CROSS VANE INSTALLATION:

1. FOOTING BOULDERS ARE BOULDERS PLACED TO PROVIDE A FOUNDATION FOR THE SURFACE BOULDERS IN EACH STEP CROSS VANE. FOOTING BOULDERS SHALL BE DURABLE LIMESTONE OR DOLOMITE. TYPICALLY, FOOTING BOULDERS ARE BURIED IN THE CHANNEL BOTTOM AND NOT SEEN WHEN THE STRUCTURE IS COMPLETED. ALL SURFACE BOULDERS FOR ALL ROCK STRUCTURES REQUIRE FOOTING BOULDERS. IF BEDROCK IS PRESENT SIRECTLY BELOW THE SURFACE BOULDER, THE FOOTING BOULDER MAY BE OMITTED AT THE DISCRETION OF THE ENGINEER.
2. SURFACE BOULDERS ARE THE TOP MOST COURSE OF BOULDERS USED IN EACH STEP CROSS VANE. ALL SURFACE BOULDERS CAN BE SEEN PROTRUDING FROM THE WATER SURFACE DURING EXTREMELY LOW FLOWS. SURFACE BOULDERS SHALL BE DURABLE LIMESTONE OR DOLOMITE.
3. THE VANE LENGTH IS THE STRAIGHT LINE PORTION OF CROSS VANE STRUCTURES MEASURED FROM THE STREAM BANK AT BANKFULL ELEVATION TO THE CHANNEL BED.
4. THE VANE ANGLE IS THE SMALLEST ANGLE MEASURED BETWEEN A VANE AND A LINE TANGENT TO BANKFULL ELEVATION AT THE POINT WHERE THE VANE INTERSECTS THE BANK.
5. CONSTRUCT STEP CROSS VANE STRUCTURES BY FIRST SHAPING THE BANK TO THE GRADES SPECIFIED. NEXT EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, GEOTEXTILE FABRIC AND GRAVEL OVERLAY. PLACE FOOTING BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT AND THEN CHECK THE ELEVATIONS OF THE INVERTS. ONCE THE INVERTS HAVE BEEN ESTABLISHED THE REMAINDER OF THE FOOTING AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS. PLACE GEOTEXTILE FILTER FABRIC AT THE UPSTREAM FACE OF THE STRUCTURE AS SHOWN AND BACKFILL (OVERLAY) WITH GRAVEL. FILL THE VOIDS ON THE UPSTREAM SIDE OF SURFACE BOULDERS WITH GRAVEL. DO NOT LEAVE EXPOSED GEOTEXTILE FABRIC AND TRIM EXPOSED GEOTEXTILE FABRIC. ONCE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE GRAVEL SUBSTRATE AS REQUIRED. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
6. THE SURFACE OF CROSS, J-HOOK AND LOG VANES SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH ROCK TO FORM A TIGHT-FITTING SEAL.
7. CONTRACTOR SHALL USE AN EXCAVATOR WITH A HYDRAULIC THUMB TO CONSTRUCT HYDRAULIC STRUCTURES.

REDUCED PRINT NOT TO SCALE

DETAIL – CROSS VANE WITH STEP

CROSSWSTEP.DWG

SCALE: NOT TO SCALE

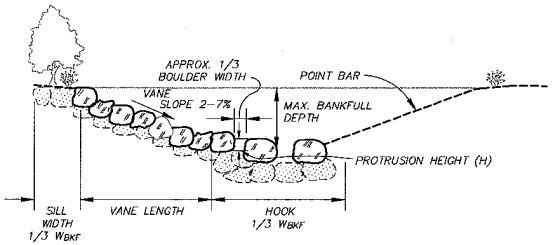
CONCEPTUAL

2008PROJ\175658029\CROSSWSTEP.DWG

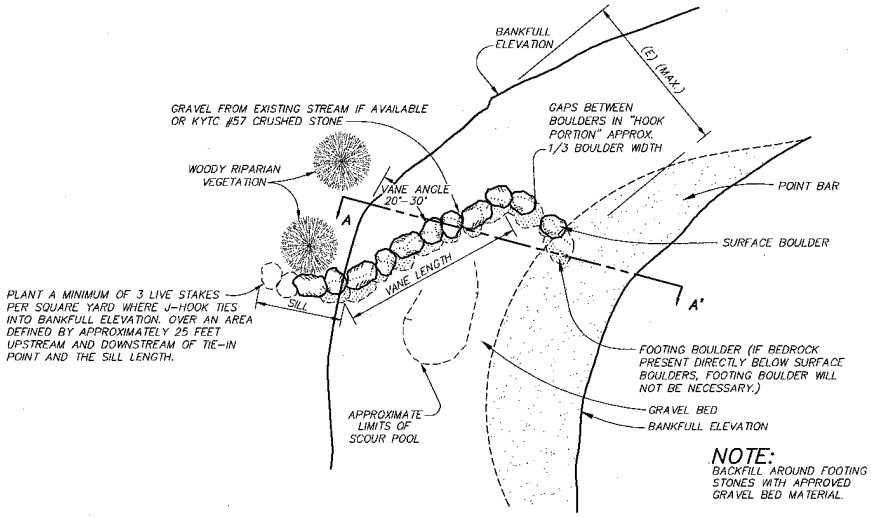
DETAILS
WOODFORD COUNTY, KENTUCKY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

USACE PROJECT NO.	LRL-2007-01461-PJL						
DRAWN BY	PJB	DATE	AUG., 2008	REVISED			SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1.		3.	4 OF 9
CHECKED BY	EB	SCALE	AS SHOWN	2.		4.	



J-HOOK – SECTION A-A'



NOTE:
BACKFILL AROUND FOOTING STONES WITH APPROVED GRAVEL BED MATERIAL.

DETAIL – J-HOOK VANE

SCALE: NOT TO SCALE J-HOOK.DWG

NOTES FOR J-HOOK VANE INSTALLATION:

1. FOOTING BOULDERS ARE BOULDERS PLACED TO PROVIDE A FOUNDATION FOR THE SURFACE BOULDERS IN EACH J-HOOK VANE. FOOTING BOULDERS SHALL BE DURABLE LIMESTONE OR DOLOMITE. TYPICALLY, FOOTING BOULDERS ARE BURIED IN THE CHANNEL BOTTOM AND NOT SEEN WHEN THE STRUCTURE IS COMPLETED. ALL SURFACE BOULDERS FOR ALL ROCK STRUCTURES REQUIRE FOOTING BOULDERS. IF BEDROCK IS PRESENT SIRECTLY BELOW THE SURFACE BOULDER, THE FOOTING BOULDER MAY BE OMITTED AT THE DISCRETION OF THE ENGINEER.
2. SURFACE BOULDERS ARE THE TOP MOST COURSE OF BOULDERS USED IN EACH J-HOOK VANE. ALL SURFACE BOULDERS CAN BE SEEN PROTRUDING FROM THE WATER SURFACE DURING EXTREMELY LOW FLOWS. SURFACE BOULDERS SHALL BE DURABLE LIMESTONE OR DOLOMITE.
3. THE VANE LENGTH IS THE STRAIGHT LINE PORTION OF CROSS VANE STRUCTURES MEASURED FROM THE STREAM BANK AT BANKFULL ELEVATION TO THE CHANNEL BED.
4. THE VANE ANGLE IS THE SMALLEST ANGLE MEASURED BETWEEN A VANE AND A LINE TANGENT TO BANKFULL ELEVATION AT THE POINT WHERE THE VANE INTERSECTS THE BANK.
5. CONSTRUCT J-HOOK VANE STRUCTURES BY FIRST SHAPING THE BANK TO THE GRADES SPECIFIED. NEXT EXCAVATE ENOUGH BED MATERIAL TO PLACE THE BOULDERS, GEOTEXTILE FABRIC AND GRAVEL OVERLAY. PLACE FOOTING BOULDERS AND SURFACE BOULDERS AT THE CHANNEL INVERT AND THEN CHECK THE ELEVATIONS OF THE INVERTS. ONCE THE INVERTS HAVE BEEN ESTABLISHED THE REMAINDER OF THE FOOTING AND SURFACE BOULDERS SHALL BE PLACED, MINIMIZING VOIDS. PLACE GEOTEXTILE FILTER FABRIC AT THE UPSTREAM FACE OF THE STRUCTURE AS SHOWN AND BACKFILL (OVERLAY) WITH GRAVEL. FILL THE VOIDS ON THE UPSTREAM SIDE OF SURFACE BOULDERS WITH GRAVEL. DO NOT LEAVE EXPOSED GEOTEXTILE FABRIC AND TRIM EXPOSED GEOTEXTILE FABRIC. ONCE STRUCTURE IS INSTALLED, EXCAVATE SCOUR POOL AND PLACE GRAVEL SUBSTRATE AS REQUIRED. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
6. THE SURFACE OF CROSS, J-HOOK AND LOG VANES SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. ALL GAPS OR VOIDS SHALL BE PLUGGED WITH ROCK TO FORM A TIGHT-FITTING SEAL.
7. CONTRACTOR SHALL USE AN EXCAVATOR WITH A HYDRAULIC THUMB TO CONSTRUCT HYDRAULIC STRUCTURES.

REDUCED PRINT NOT TO SCALE

CONCEPTUAL

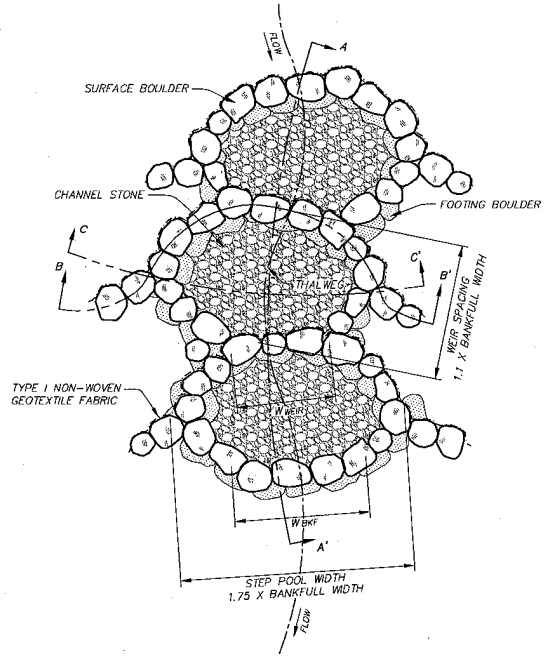
2008PROJ\175658029\J-HOOK.DWG

DETAILS
WOODFORD COUNTY, KENTUCKY

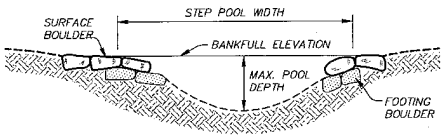
Stantec
Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

USACE PROJECT NO. LRL-2007-01461-PJL

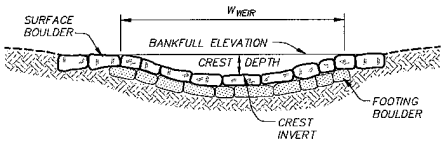
DRAWN BY	PJB	DATE	AUG., 2008	REVISED		SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1.	3.	5 OF 9
CHECKED BY	EB	SCALE	AS SHOWN	2.	4.	



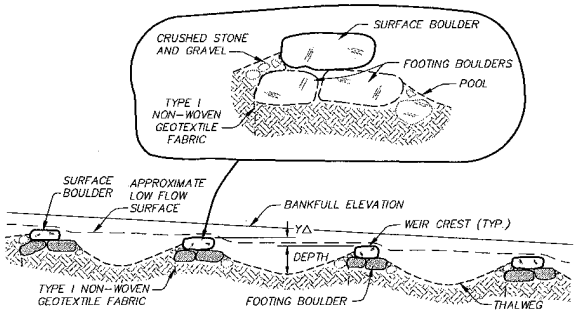
STEP POOL PLAN



STEP POOL SECTION C–C'



STEP POOL WEIR – SECTION B–B'



STEP POOL PROFILE – A–A'

DETAIL – STEP POOL

NOT TO SCALE

STEPPOOL.DWG

REDUCED PRINT NOT TO SCALE

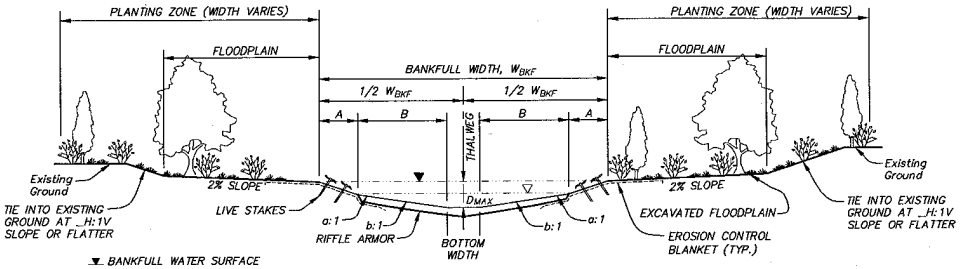
CONCEPTUAL

Z:\DBPROJ\175658029\STEPPOOL.DWG

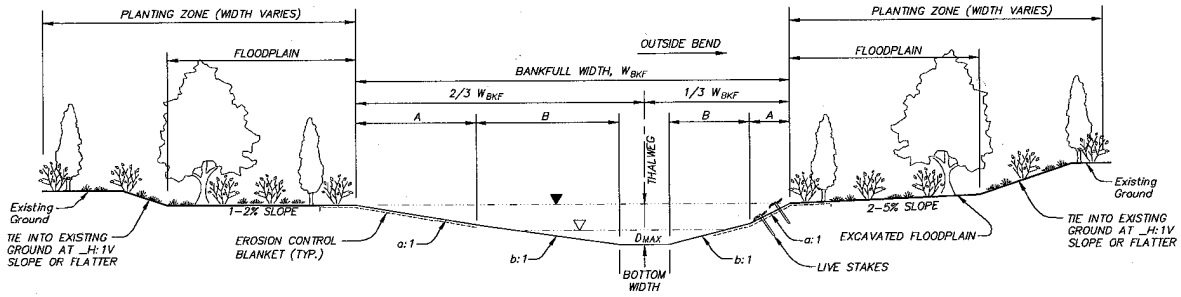
DETAILS
WOODFORD COUNTY, KENTUCKY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2030
859-422-3000
www.stantec.com

USACE PROJECT NO.	LRL-2007-01461-PJL				
DRAWN BY	PJB	DATE	AUG., 2008	REVISED	SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1. 3.	6 OF 9
CHECKED BY	EB	SCALE	AS SHOWN	2. 4.	



RIFFLE



POOL

TYPICAL SECTION – TYPE _ STREAM						
	RIFFLE			POOL		
STREAM	MINIMUM	AVERAGE	MAXIMUM	MINIMUM	AVERAGE	MAXIMUM
BANKFULL AREA A_{BKF} (FT^2)	200	215	230	220	252	286
MAX BANKFULL DEPTH D_{MAX} (FT)	4.8	5.2	5.6	7.5	8.5	9.5
BANKFULL WIDTH (FT)	44	48	52	44	46	50
BOTTOM WIDTH (FT)	8	12	16	8	11	15
A	4	6	8	4	6	8
B	8	12	16	8	11	15
a:1	4	2	1	4	2	1
b:1	4	3	2	4	3	2

TYPICAL SECTION – PRIORITY II – TYPE _ STREAM

SCALE: NOT TO SCALE

TYP STREAM XS PRIORITY 2.DWG

NOTES:

1. CONSTRUCT CHANNEL CROSS-SECTIONS AS SHOWN AT ALL RIFFLE AND POOL LOCATIONS. PROVIDE A SMOOTH TRANSITION BETWEEN RIFFLES AND POOLS USING DEPTHS SHOWN ON THE PROFILE.
2. SLOPES SHOWN ARE H:V.
3. EXCAVATE BOTTOM WIDTH TO PROPER DEPTHS ALONG THALWEG THEN EXCAVATE SIDE SLOPES OF CHANNEL AS SHOWN.
4. RIFFLES MAY NEED TO BE OVER EXCAVATED TO FACILITATE PLACEMENT OF RIFFLE MATERIAL AS SHOWN IN DETAIL.
5. SEE PLAN SHEET(S) FOR FLOODPLAIN EXCAVATION LIMITS.
6. PLANTING ZONE SHOWN HERE FOR ILLUSTRATIVE PUPOSES. SEE SHEET __ FOR PLANTING ZONE LIMITS. MULTIPLE ZONES MAY EXIST WITHIN LIMITS OF SECTIONS.

CONCEPTUAL

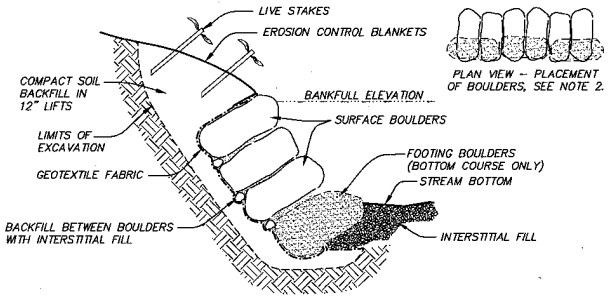
REDUCED PRINT NOT TO SCALE

2008\PROJ\175658029\TYP-SECTIONS

DETAILS
WOODFORD COUNTY, KENTUCKY

Stantec
Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

USACE PROJECT NO.	LRL-2007-01461-PJL				
DRAWN BY	PJB	DATE	AUG., 2008	REVISED 1. 3.	SHEET 7 OF 9
CHECKED BY	JE	PROJ. NO.	175658029	2. 4.	
CHECKED BY	EB	SCALE	AS SHOWN		



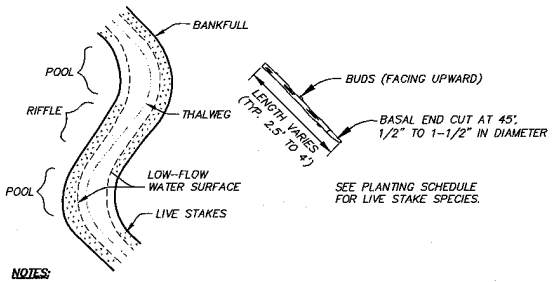
NOTE:

1. PLACE BOULDERS BELOW BANKFULL ELEVATION FLUSH WITH FINISHED CHANNEL BANK AS SHOWN.
2. EACH LIFT OF BOULDERS SHALL BE PLACED WITH THE LONG AXIS PERPENDICULAR WITH THE LONG AXIS OF THE BOULDERS PLACED IN THE LOWER COURSE.
3. FOOTING BOULDERS MAY BE RECYCLED CONCRETE FREE OF REINFORCING STEEL.
4. BACKFILL AND COMPACT BEHIND BOULDERS IN 12" LIFTS.

DETAIL – IMBRICATED STONE TOE

SCALE: NOT TO SCALE

STONE TOE - IMBRICATED.DWG



NOTES:

1. LIVE STAKES SHALL BE INSTALLED ALONG THE OUTER MEANDER BEND WHERE INDICATED ON THE DRAWINGS AND DETAILS.
2. LIVE STAKES SHALL BE CUT FROM AN APPROVED SOURCE WITH A SHARP TOOL. STAKE SHALL BE FREE FROM DISEASE OR EXCESS DEAD TWIGS, 2.5 TO 4 FEET IN LENGTH WITH A BASAL END 0.5 TO 1.5 INCH IN DIAMETER. PRIOR TO INSTALLATION BASAL END SHALL BE CUT AT A 45 DEGREE ANGLE AND THE END SHALL BE CUT FLAT WITHOUT CRACKS.
3. LIVE STAKES SHALL BE INSTALLED BY GENTLY TAMPING INTO THE SOIL LEAVING 4 TO 8 INCHES EXPOSED. STAKES SHALL BE PLACED IN A RANDOM PATTERN AT A RATE OF 1 LIVE STAKE PER SQUARE YARD ALONG BANKS.
4. LIVE STAKES SHALL BE INSTALLED WHEN THEY ARE DORMANT, WHICH TYPICALLY OCCURS BETWEEN NOVEMBER 15 AND MARCH 15.

DETAIL – DORMANT LIVE STAKE DETAIL

SCALE: NOT TO SCALE

LIVE STAKE PLAN.DWG

REDUCED PRINT NOT TO SCALE

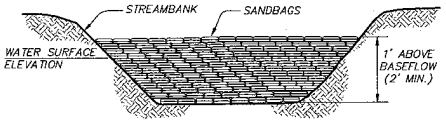
CONCEPTUAL

2008PROJ\175658029\BOULDER- TOE.DWG

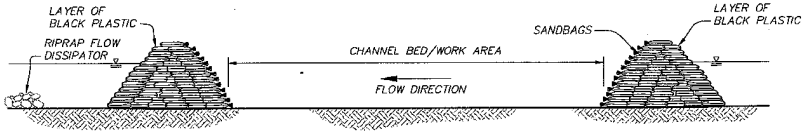
DETAILS
WOODFORD COUNTY, KENTUCKY

Stantec
Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

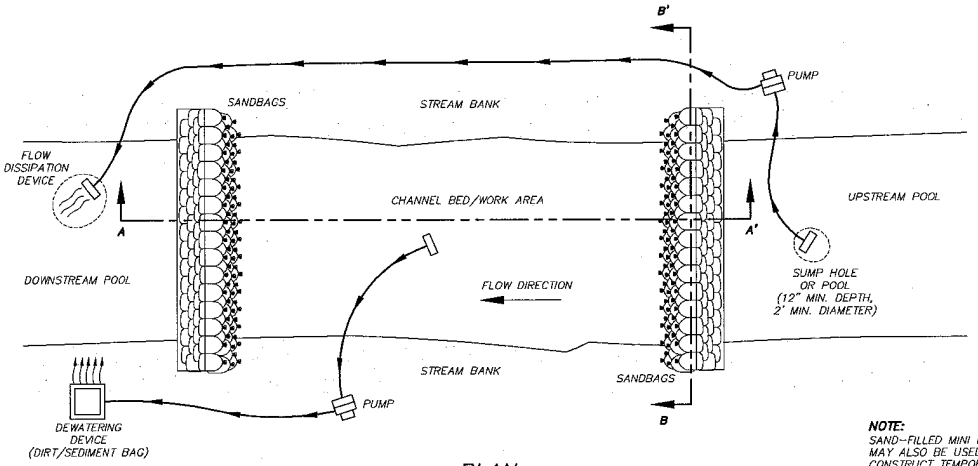
USACE PROJECT NO.	LRL-2007-01461-PJL				
DRAWN BY	PJB	DATE	AUG., 2008	REVISED	SHEET
CHECKED BY	JE	PROJ. NO.	175658029	1. 3.	8 OF 9
CHECKED BY	EB	SCALE	AS SHOWN	2. 4.	



SECTION B–B'



SECTION A–A'



PLAN

NOTE:
SAND–FILLED MINI BULK BAGS MAY ALSO BE USED TO CONSTRUCT TEMPORARY DAMS INSTEAD OF CONVENTIONAL SAND BAGS.

DETAIL – PUMP AROUND

SCALE: NOT TO SCALE

POMPAROUND.DWG

REDUCED PRINT NOT TO SCALE

CONCEPTUAL

2008PROJ\175658029\PUMP-AROUND.DWG

DETAILS
WOODFORD COUNTY, KENTUCKY

Stantec
Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511–2050
859–422–3000
www.stantec.com

USACE PROJECT NO. LRL–2007–01461–PJL

				REVISED		SHEET
DRAWN BY	PJB	DATE	AUG., 2008	1.	3.	9 OF 9
CHECKED BY	JE	PROJ. NO.	175658029	2.	4.	
CHECKED BY	EB	SCALE	AS SHOWN			

Attachment 5 - Glenn's Creek Geomorphic Assessment*

Completed by Eco-Tech Consultants, Inc. (2008)

*Pre April 2008 Flooding

GLENNS CREEK GEOMORPHIC ASSESSMENT AT THE OLD CROW DISTILLERY IN WOODFORD COUNTY, KENTUCKY (KDOW AI NO. 40205)

Prepared for:
Jim Beam Brands, Inc.

Prepared by:
Eco-Tech Consultants, Inc.
Frankfort, Kentucky

January 2008

ETC ECOLOGICAL
Eco-Tech Consultants, Inc.

GLENNS CREEK GEOMORPHIC ASSESSMENT AT THE OLD CROW DISTILLERY IN WOODFORD COUNTY, KENTUCKY (KDOW AI NO. 40205)

TABLE OF CONTENTS

APPENDICES

1.0 Introduction

1.1 Project Description

Eco-Tech Consultants, Inc. (Eco-Tech) was contracted by Jim Beam Brands Co., Inc to conduct a geomorphic assessment of Glenns Creek at the Old Crow Distillery in Woodford County, Kentucky. This assessment was requested by Kentucky Division of Water (KDOW) in the *Request for Additional Information* (November 19, 2007) in response to a permit application for work completed at the site without a U.S. Army Corps of Engineers (USACE) 404 permit or KDOW Water Quality Certification. The work completed included the removal of accumulated fine and coarse sediment to the underlying bedrock within the stream channel for approximately 1,200 linear feet. Mechanically moved material was spread along the stream banks and stockpiled within the floodplain. Additionally, just upstream of the facility access bridge, loose material and two to three feet of bedrock was removed in an attempt to alleviate flood concerns caused by the undersized bridge cross section.

After completion of the work and subsequent after-the-fact consultation with KDOW, Jim Beam Brands submitted an application for Water Quality Certification (WQC). The application was found to be deficient in the necessary technical components of stream assessment and design. Consequently, the WQC application was removed from consideration in the KDOW *Application Withdrawn* letter (December 17, 2007). Eco-Tech was then retained as agent to prepare geomorphic stability assessment and subsequent enhancement of the stream channel to a more stable condition.

The Old Crow Distillery is located approximately 3.5 miles southeast of Frankfort, Kentucky along Glenns Creek Road (Figures 1 and 2). The impacted section of Glenns Creek is approximately 1.5 miles upstream of the confluence with the Kentucky River. Glenns Creek at the project site has a drainage area of 16 square miles and is situated within the Kentucky River Basin and US Geological Survey (USGS) hydrological unit code (HUC) 05100205240.

1.2 Methods

Eco-Tech personnel investigated the existing conditions of Glenns Creek at the Old Crow Distillery site by incorporating standard stream dimension, sediment, and entrainment assessment measures. Longitudinal profiles, cross sections, and topographic data were collected using a combination of total station, laser level, and survey-grade GPS instruments. A professional land surveyor, James E. Spurrier Land Surveyors, was subcontracted to aid in the collection of site and elevation data.

For the purposes of this assessment, Glenns Creek at the project site was separated into four reaches, Reference Reach, Reach A, Reach B and Reach C. The Reference Reach begins approximately 700 linear feet upstream of the impact area and ends at the beginning of the impact area. This section of stream was chosen as a reference because it illustrated the condition of the impact area before alterations to the bed and bank were implemented. Reach

A begins at the impact area and ends at the bridge crossing. Reach A encompasses the upstream end of the impact area and includes a concrete low-water crossing located near the present bridge. Reach B begins just downstream of the bridge crossing and continues to the end of the impact area. Reach B encompasses the downstream end of the impact area and was separated from Reach A to note any effects of the impacts downstream of the low-water crossing and bridge area. Reach C begins at the end of the impact area and ends approximately 400 linear feet downstream. Reach C was surveyed in order to note the effects on the stream channel from the upstream impacts.

Existing longitudinal profiles were conducted by identifying grade changes within the stream channel and surveying specific points at those changes. These specific locations included top of bank, bankfull, waters edge or surface, and thalweg. In addition, 11 cross sections on Glenns Creek were selected and surveyed at representative stream features throughout the site. These cross sections served to characterize the dimension of the existing channel.

The stream bed along Glenns Creek was characterized using two protocols, the modified Wolman Pebble Count (Rosgen, 1994) and the pavement/sub-pavement sample analysis. Samples taken between bankfull elevations at two pool and non-pool locations (one in the Reference Reach and one in Reach C) were categorized as "Classification" samples and those taken below the water surface at one riffle area in the Reference Reach were used as the "Wetted Perimeter" samples. The classification samples determine the stream's material size as it relates to bankfull events and its overall stream material classification. The wetted perimeter samples are used to describe the movement of surface sediment within the active bed.

The pavement/sub-pavement sample analysis provides data for both comparison purposes and sediment transport validations. One way to calculate sediment transport for a stream site is with sediment transport competency. Competency is a stream's ability to move particles of a given size. It is expressed as a measure of force (lbs/ft^2) and calculated as critical dimensionless shear stress and critical shear stress. The critical dimensionless shear stress ($\tau^*_{ci)is}$ the measure of force required to initiate general movement of particles in a bed of a given composition. This calculation is part of several calculations used to determine aggradation/degradation along the stream channel. For gravel-bed streams, the critical dimensionless shear stress is generally calculated using surface and subsurface particle samples from representative riffle sections. The critical dimensionless shear stress calculation is presented below.

$$\tau^*_{ci} = 0.0384 \left(d_i/d_{50}\right)^{-0.887}$$ where, τ^*_{ci} = critical dimensionless shear stress (lbs/ft^2)

d_i = largest particle from sub-pavement sample (mm)

d_{50} = median particle size of riffle bed surface (mm)

The shear stress placed on the sediment particles is the force that entrains and moves the particles. The critical shear for the channel has to be sufficient to move the $_{D84}$ of the bed material. The critical shear stress was calculated and plotted on the Modified Shield's curve to determine the approximate size of particles that will be moved (Rosgen, 2002). The critical shear stress calculation is presented below.

$\tau_c = \gamma RS$ where,

τ_c = critical shear stress (lbs/ft^2)
γ = the density of water (62.4 lbs/ft^3)
R = hydraulic radius (ft)
S = bankfull water surface slope (ft/ft)

2.0 Results

2.1 Longitudinal Profile

A summary of the longitudinal profile data collected along Glenns Creek at the project site is located in Table 1. Graphs depicting bankfull, waters edge or surface, and thalweg for the entire project site can be found in Appendix A. For the purposes of the summarizing the data the stream was separated into three reaches, the Reference Reach, Reach A and B combined and Reach C. Reach A and B were combined because they represent the entire impact area.

Table 1. Summary of Existing Longitudinal Profile – Glenns Creek

Reach	Channel Slope	Valley Slope	Pool Slope	Riffle Slope	Depth of Riffles (ft)	Depth of Pools (ft)
Reference	0.010	0.009	0.001-0.009	0.021-0.039	0.55-1.21	1.08-2.77
Reach A and B*	0.006	0.009	0.003	0.006	0.3-1.53	1.70
Reach C*	0.005	0.009	--	0.005	0.51-1.19	--

*Notes: Reach A and B were combined because they represent the entire impact area. No ranges were given for Reach A and B because only one riffle exists. No true pools were found in Reach C.

Glenns Creek is classified as a F3 channel along the entire length of the project site according to the Rosgen stream classification system (Rosgen, 1994).

2.2 Cross Sections

A summary of the cross section data collected along Glenns Creek at the project site is located in Table 2. Graphs depicting bankfull and floodprone area for the cross sections can be found in Appendix A.

Table 2. Summary of Existing Cross Sections – Glenns Creek

Cross Section	Station No.	Morph. Feature	Bankfull Area (ft^2)	Ent. Ratio*	W/D Ratio*	Wetted Perimeter (ft)	Hydraulic Radius (ft)
Reference	2+43	Run	79.6	1.2	38.8	56.0	1.4
Reference	3+65	Pool	154.2	--	--	53.2	2.9
Reference	4+13	Glide	125.2	--	--	58.4	2.1
Reference	4+63	Riffle	117.3	1.3	30.6	60.8	1.9
Reach A*	0+40	Run	96.5	1.4	23.6	48.4	2.0
Reach A*	2+16	Riffle #1	104.3	1.5	21.5	48.1	2.2
Reach A*	3+72	Riffle #2	104.0	1.4	28.0	54.7	1.9
Reach A*	6+60	Riffle #3	107.3	1.3	28.5	56.1	1.9
Reach B*	10+31	Run	112.9	1.3	13.0	41.2	2.7
Reach B*	11+48	Pool	123.4	--	--	49.6	2.5
Reach C	0+96	Riffle	100.7	1.6	22.0	48.1	2.1

*Notes: Ent. Ratio is "Entrenchment Ratio"
W/D Ratio is "Width/Depth Ratio"
Bankfull for Reaches A and B was estimated due to elimination of bank features

2.3 Sediment Analysis

The composition of the stream bed is an important facet of stream character, influencing channel form and hydraulics. According to the modified Wolman Pebble Count procedure from the classification pebble count, the average $_{d50}$ (50% of the sampled population is equal to or finer than the representative particle diameter) is approximately 68.5 mm for the Reference Reach and 73.4 mm for Reach C of Glenns Creek, which falls into the small cobble size category. Samples were not taken in Reaches A and B due to the removal of stream bed material leaving only bedrock exposed. The particle size distribution data which includes the classification, wetted perimeter, and pavement/sub-pavement sample are presented in the Appendix B. Sediment also plays a major role in the influence of channel stability and morphology (Rosgen 1996). The critical dimensionless shear stress equation noted in the methods section was one of the equations used to calculate the transport capabilities of this stream. Using the sub-pavement and wetted perimeter samples from the Reference Reach, the $_{di}$ (largest particle in the sub-pavement sample) was calculated to be 139 mm and the $_{d50}$ (median particle size of the riffle bed) was calculated to be 104.4 mm. The critical dimensionless shear stress was then determined to be 0.0297 lbs/ft^2. A suitable bar sample location was not present within the surveyed reaches. Thus the pavement/sub-pavement procedure was used.

The other equation used to calculate sediment transport was the critical shear stress equation also noted in the methods section. Based on R (hydraulic radius) of 1.93, S (bankfull water surface slope) of 0.01 and the Modified Shield's curve, a particle the size of 100 mm could be moved within the Reference Reach of the Glenns Creek channel at bankfull. The largest particle found in the sub-pavement sample was 139 mm. The $_{D84}$ ^{and} D_{100} in from the active riffle bed

are 154 mm and 244 mm, respectively. Therefore, the present stream channel does not have sufficient shear to move the bedload associated with this reach and aggradation potential exists.

3.0 Discussion

Visual observations of the stream channel concluded that many years ago a concrete structure approximately the width of the stream had been constructed near the present bridge site in order to provide a low-water crossing. The removal of the sediment within the stream channel has caused a significant decrease in the stream bed elevation especially surrounding the bridge area as evident in the downstream end of the longitudinal profile of Reach A. This significant decrease in elevation over a short distance has caused a waterfall effect at the concrete low-water crossing structure and the adjoining bridge area. Because the shape of the concrete structure directs the water to the left streambank and the force of the water is so great in that area the left streambank at the structure is actively failing and becoming increasingly unstable.

The longitudinal profile of Reaches A and B also show that the removal of sediment has left the entire impact reach without riffle-pool sequences observed in stable stream channels. The riffle-pool sequences are essential to the equilibrium of the stream and macroinvertebrate and fish habitat. Riffles tend to be composed of gravel and cobble substrate that acts to re-aerate the water, as a nesting area for fish and an area for macroinvertebrate and juvenile fish populations. Pools on the other hand are usually composed of finer material that is deposited by the slower moving water and support larger adult fish populations. Only a few small fish were observed in the impact area of Glenns Creek.

The data collected from the cross sections throughout all the reaches of the Glenns Creek project site indicate the channel is overwidened, as evident in the high width/depth ratios. The result of high width/depth ratios is excessive sediment deposition. The critical shear stress calculations also suggest aggradation could occur and a mid-channel bar was observed in the upstream end of Reach A.

A retaining wall constructed along the right streambank of Reach B and C has also contributed to the instability of the stream channel. The cross section for the run in Reach B depicts a vertical leap from the water's edge to the top of the wall. This retaining wall contains the water within channel, and therefore it does not have access to any floodplain on that right streambank. The floodplain is further restricted as the stream abuts a steep hill side slope on the left bank.

The removal of sediment has also left the entire impact area with a stream bed composed of exposed bedrock. This bedrock has stabilized the impact area stream channel vertically by not allowing further incision to occur, however in the Reference Reach just upstream of the impact area, a headcut is forming in order to adjust to the overwidening and elevation change downstream. This headcutting will continue upstream thus increasing the instability of Glenns Creek.

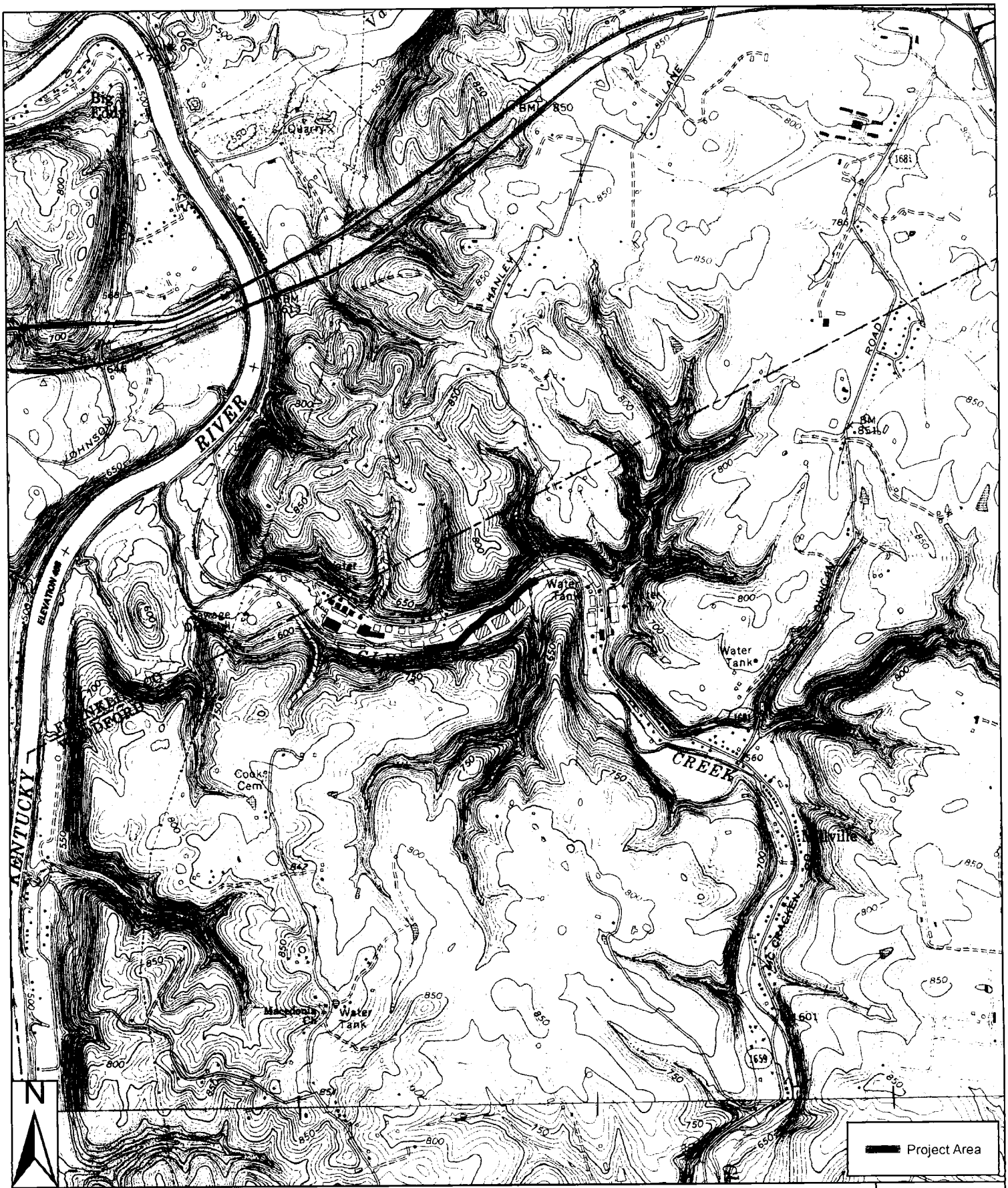
4.0 Recommendations

The increasing instability of Glenns Creek throughout the impact area can be minimized through the use of structures and constructed riffles. Structures such as cross vanes and bedrock step reshaping could be employed to direct water away from bridge abutments and unstable banks. Constructing riffles with the removed sediment would increase riffle-pool sequences and provide suitable habitat for macroinvertebrates and fish populations. Former channel material currently lining the banks should be removed before potentially being washed back into the channel by high flows. Bare soil should be stabilized using appropriate tensile erosion control fabric. Stockpiled material should be outside of the active floodplain and controlled for erosion. This material would be re-used in the construction of in-channel riffles. The conceptual design phase incorporating suitable remedies is set to begin immediately.

5.0 References

Rosgen, D.L. 1994. A Classification of Natural Rivers. Catena, 22:169-199.

Rosgen, D.L. 2002. River Asssessment and Monitoring Field Guide. Pagosa Springs, Colo.: Wildland Hydrology Inc.



WOODFORD	
County:	
KENTUCKY	
State:	
1:24,000	

Figure 1. PROJECT LOCATION MAP

Glenns Creek Geomorphic Assessment
at the
Old Crow Distillery
USGS Frankfort East Topographic Quadrangle

ETC
1003 E Main Street
Frankfort, KY 40601
502-695-8060

Project Area Glenns Creek	WOODFORD *County:* KENTUCKY *State:* 1:10,000	**Figure 2. SITE LOCATION MAP** Glenns Creek Geomorphic Assessment at the Old Crow Distillery *2004 NAIP DOQQ*	ETC 1003 E Main Street Frankfort, KY 40601 502-695-8060

James E. Spurrier
Land Surveying
1102 Pawnee Dr.
Elizabethtown, Ky. 42701
Office (270) 723-5720
Fax (270) 737-3452
espurrier_pls3695@yahoo.com

PLAN VIEW
OF
GLENN'S CREEK
AT
OLD CROW DISTILLERY
FRANKFORT, KY

Field Work: JANUARY - 2008
Plot Date: 1-21-2008
Project #: 08-01
Field Book: 2
Page: 60-64
Cogo File: SURVEYS\JIMSFAM\OLDCROW\08-01.ZAK
Drawing File: FINAL-1.DRG

SURVEYOR'S NOTES

THIS SURVEY IS TIED TO THE KY. STATE PLANE COORDINATE SYSTEM NAD 83 (2007). VERTICAL DATUM OF NAVD 88 REFERENCED TO FEDERAL BASE NETWORK MONUMENT (GNAU) AT THE FRANKFORT DEPT. OF TRANSPORTATION.

NOTE THAT HAUL ROADS WERE LOCATED ON DRAWING USING AERIAL PHOTO OVERLAY AND ARE APPROXIMATE LOCATIONS.

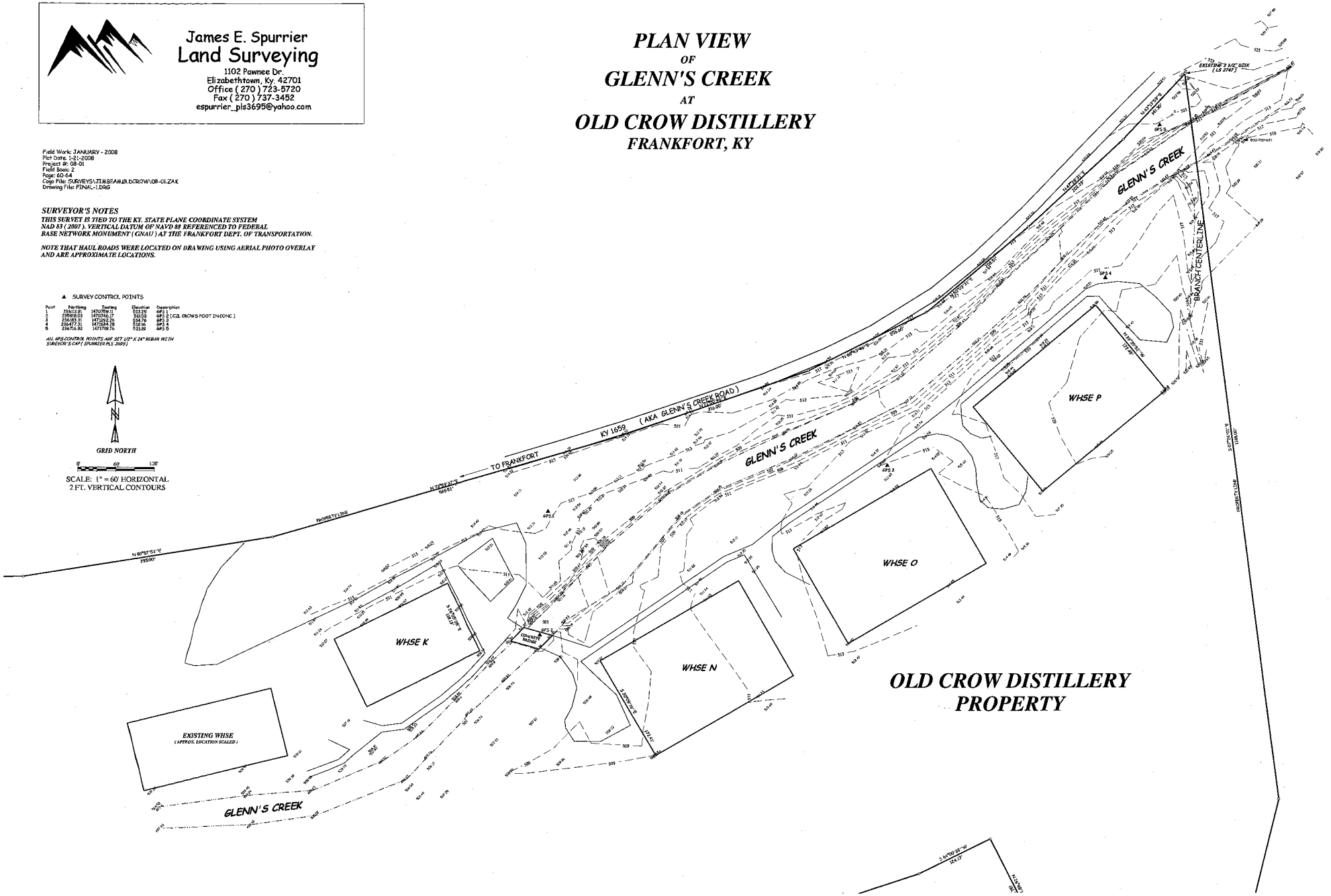
▲ SURVEY CONTROL POINTS

Point	Northing	Easting	Elevation	Description
1	238418.91	1470778.11	523.29	GPS 1
2	237918.03	1470746.19	511.58	GPS 2 (CL CROWS FOOT 2 NCONC)
3	236183.31	1471316.26	516.76	GPS 3
4	236477.31	1471534.28	518.16	GPS 4
5	236716.82	1471719.76	521.09	GPS 5

ALL GPS CONTROL POINTS ARE SET 1/2" X 24" REBAR WITH SURVEYOR'S CAP (SPURRIER PLS 3695)

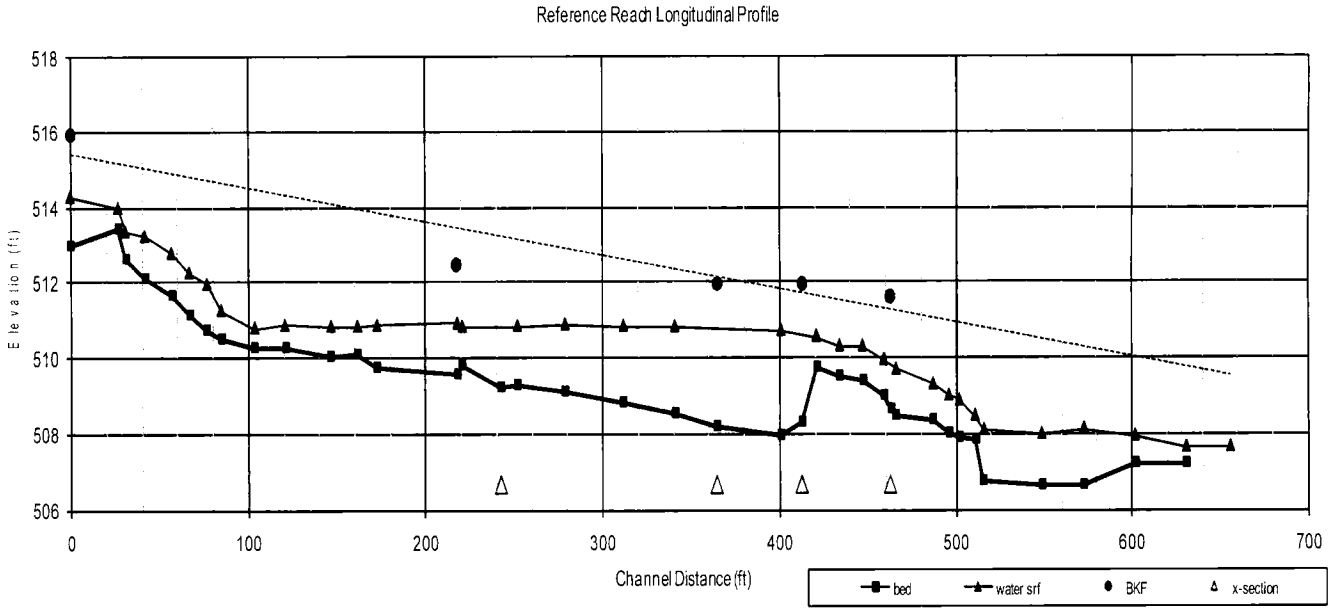
GRID NORTH

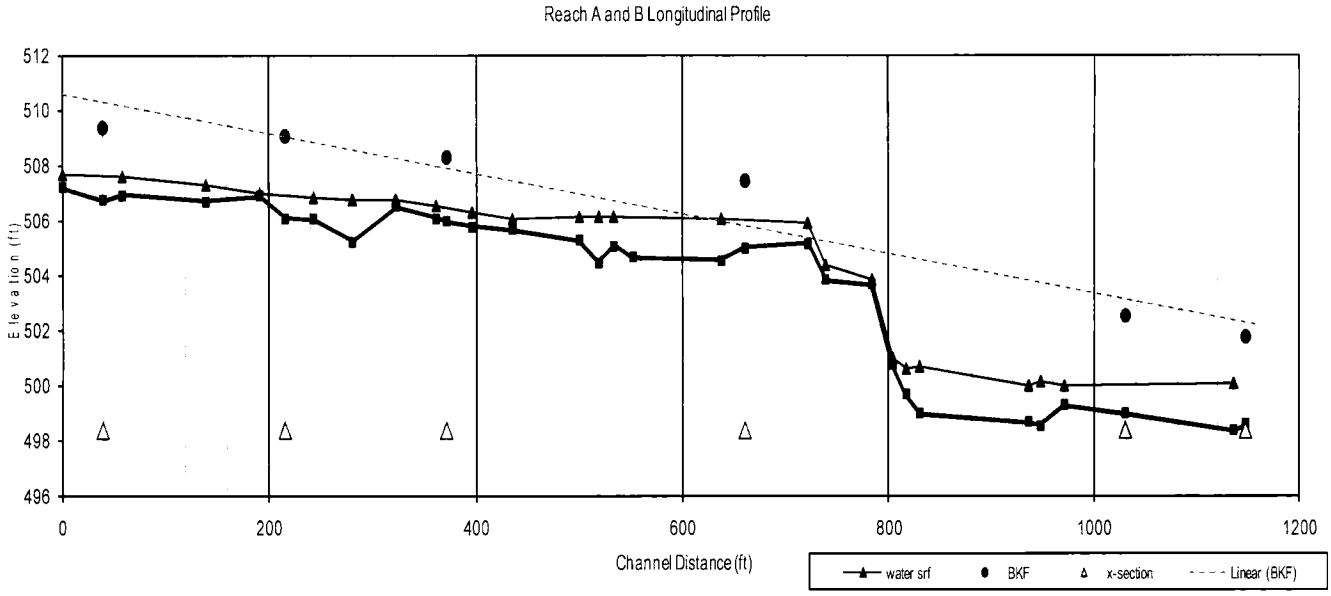
SCALE: 1" = 60' HORIZONTAL
2 FT. VERTICAL CONTOURS

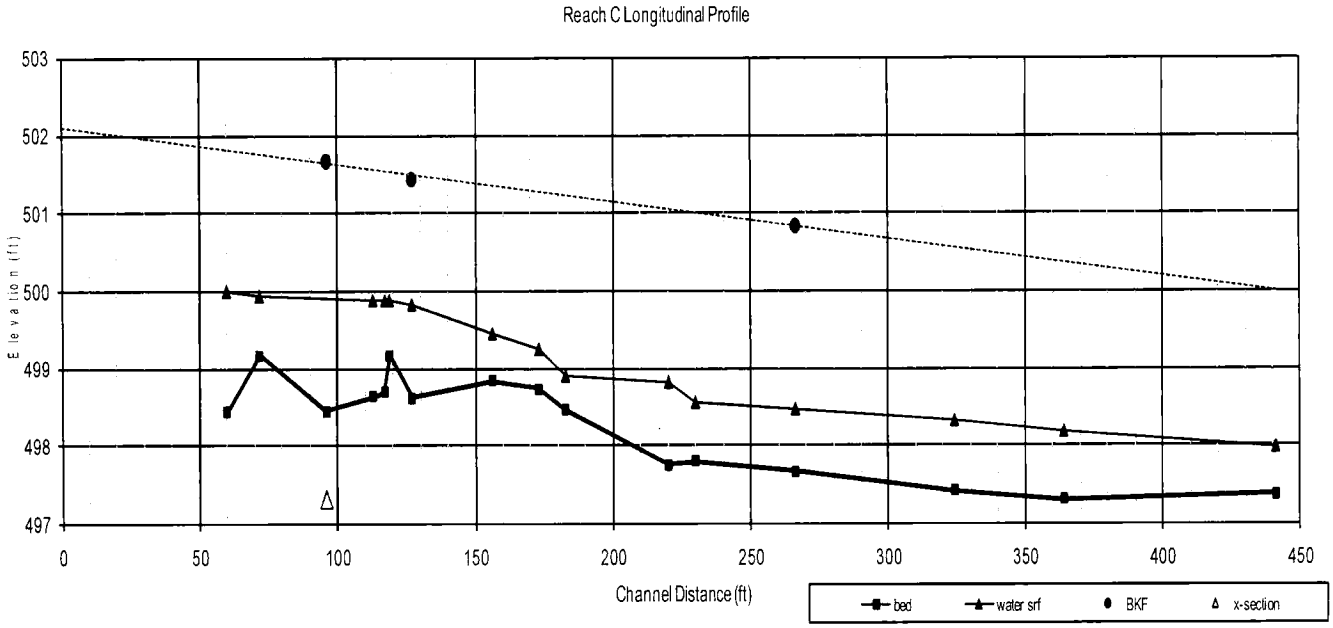


OLD CROW DISTILLERY PROPERTY

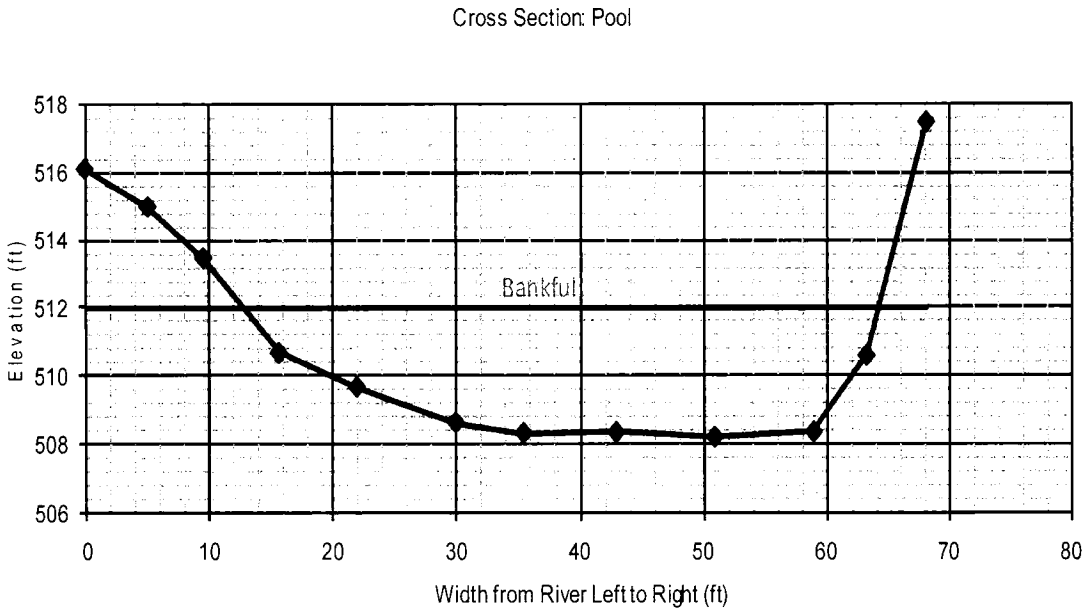
APPENDIX A

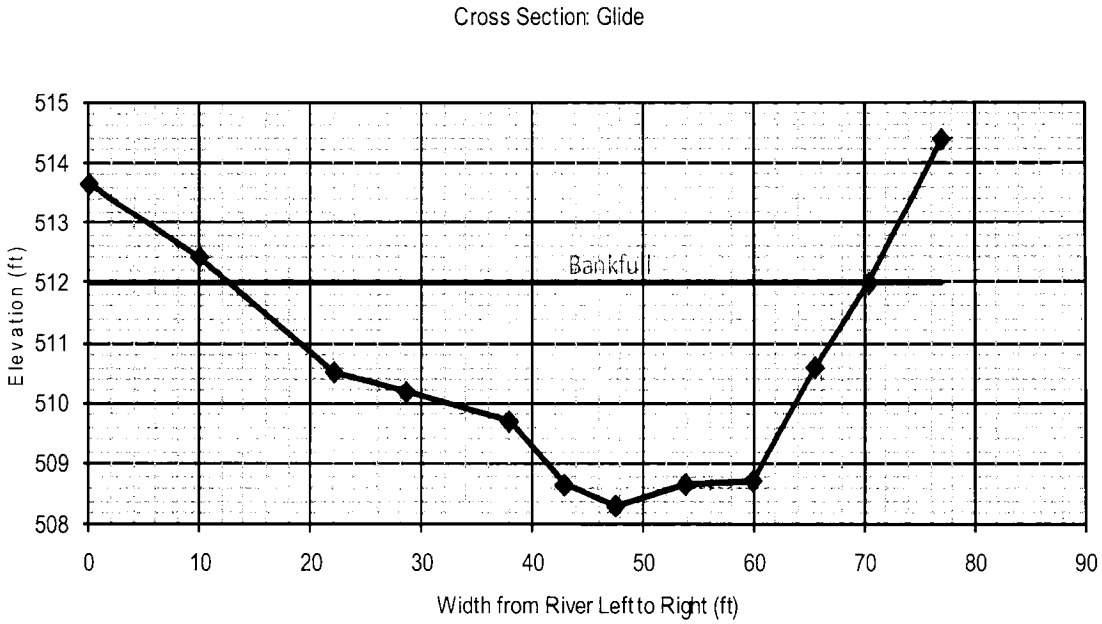

Reference Reach Longitudinal Profile
518
516
514
512
510
508
506
Elevation (ft)
0
100
200
300
400
500
600
700
Channel Distance (ft)
bed
water srf
BKF
x-section


Reach A and B Longitudinal Profile
512
510
508
506
504
502
500
498
496
Elevation (ft)
0
200
400
600
800
1000
1200
Channel Distance (ft)
water srf
BKF
x-section
Linear (BKF)


Reach C Longitudinal Profile
503
502
501
500
499
498
497
Elevation (ft)
0
50
100
150
200
250
300
350
400
450
Channel Distance (ft)
bed
water srf
BKF
x-section

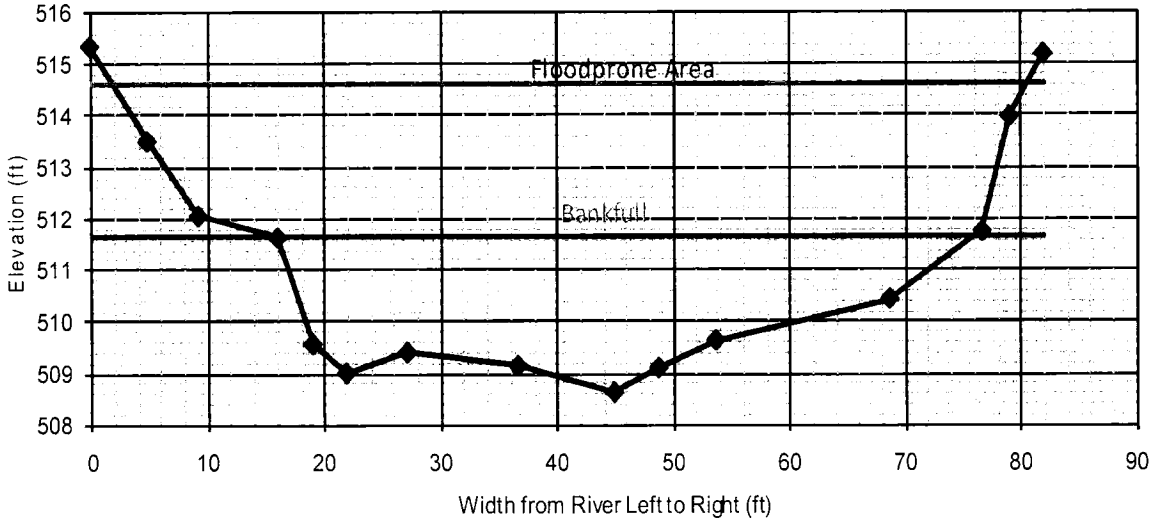
Reference Reach Cross Sections



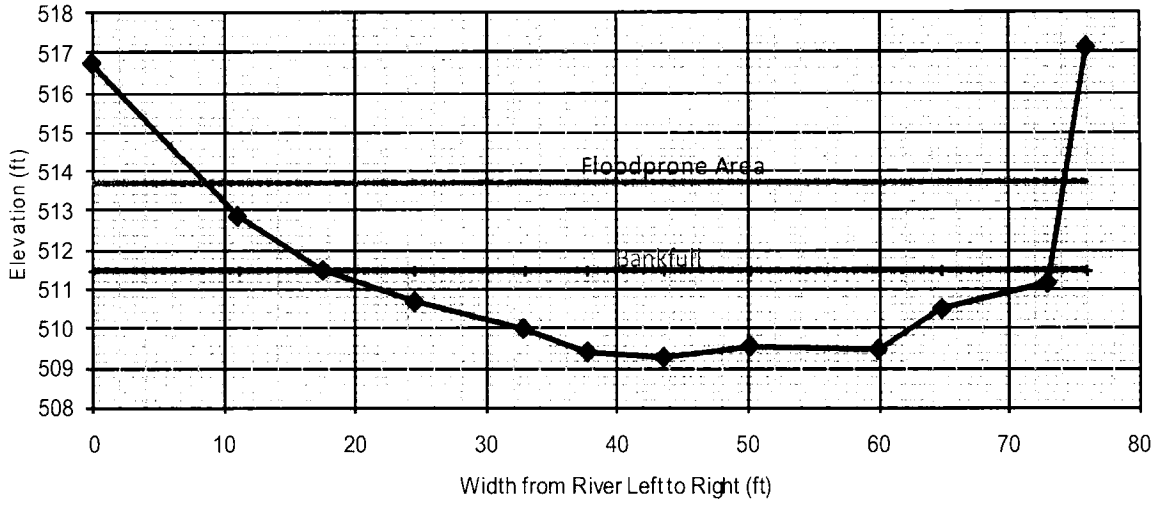


Reference Reach Cross Sections Continued

Cross Section: Riffle

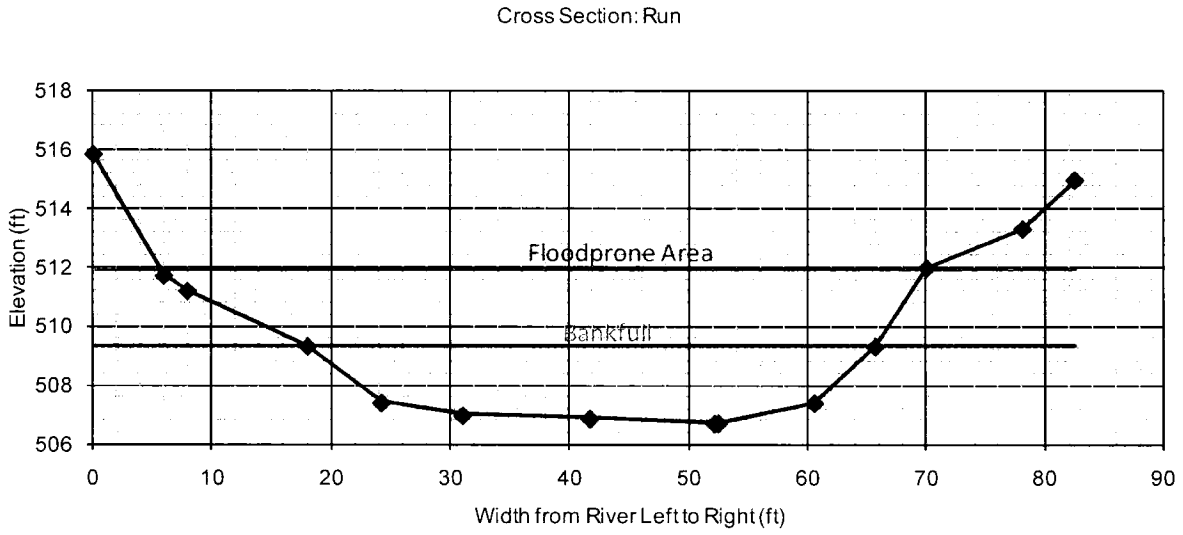


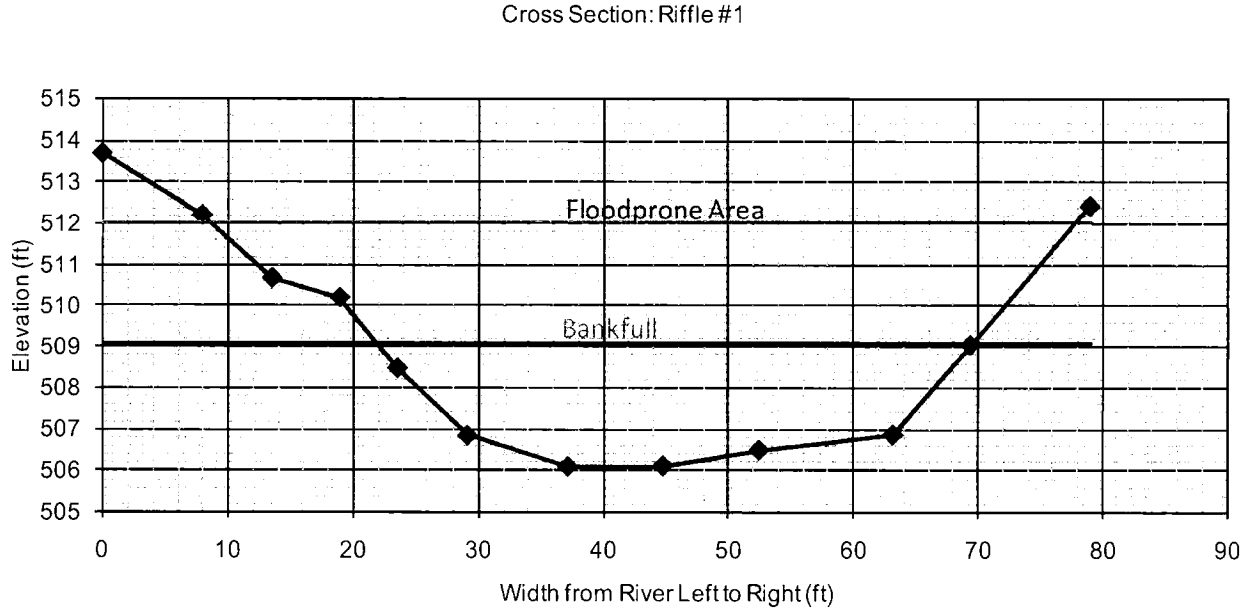
Cross Section: Run



Reach A Cross Sections

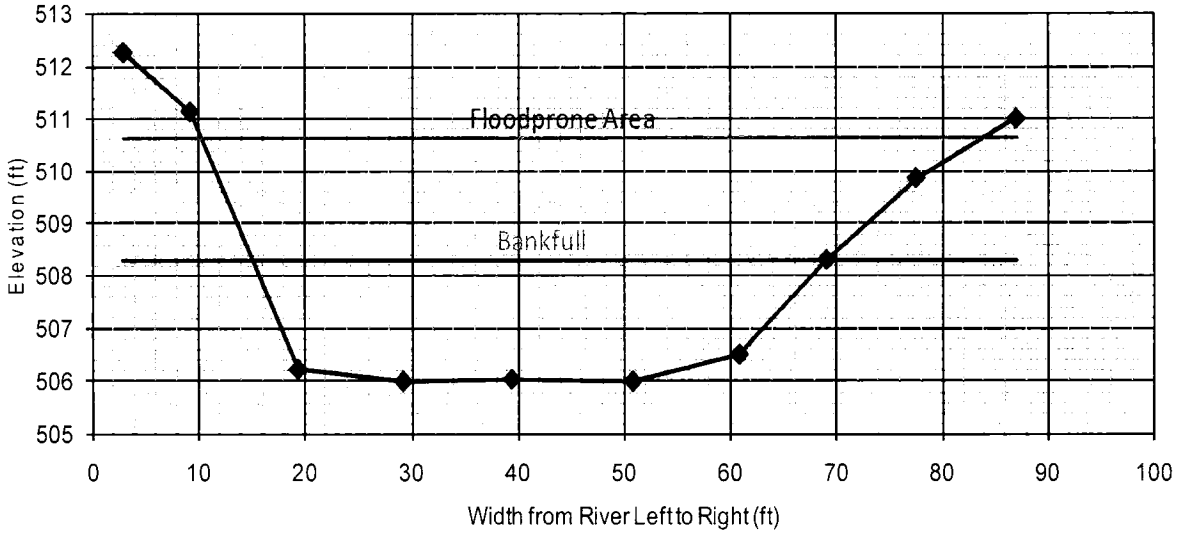
An estimated bankfull elevation was determined for Reach A because no bankfull indicators were identified during field surveys.



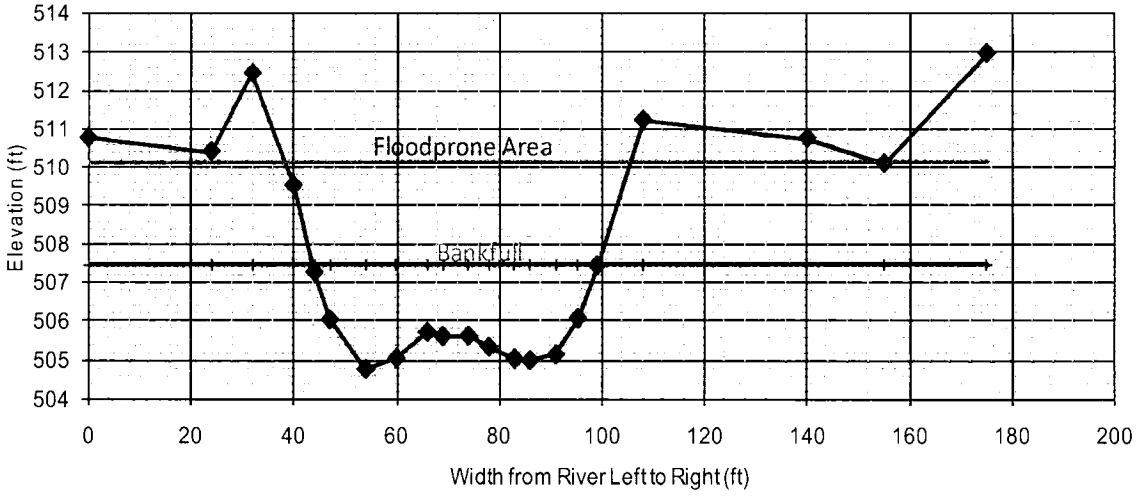


Reach A Cross Sections Continued

Cross Section: Riffle #2

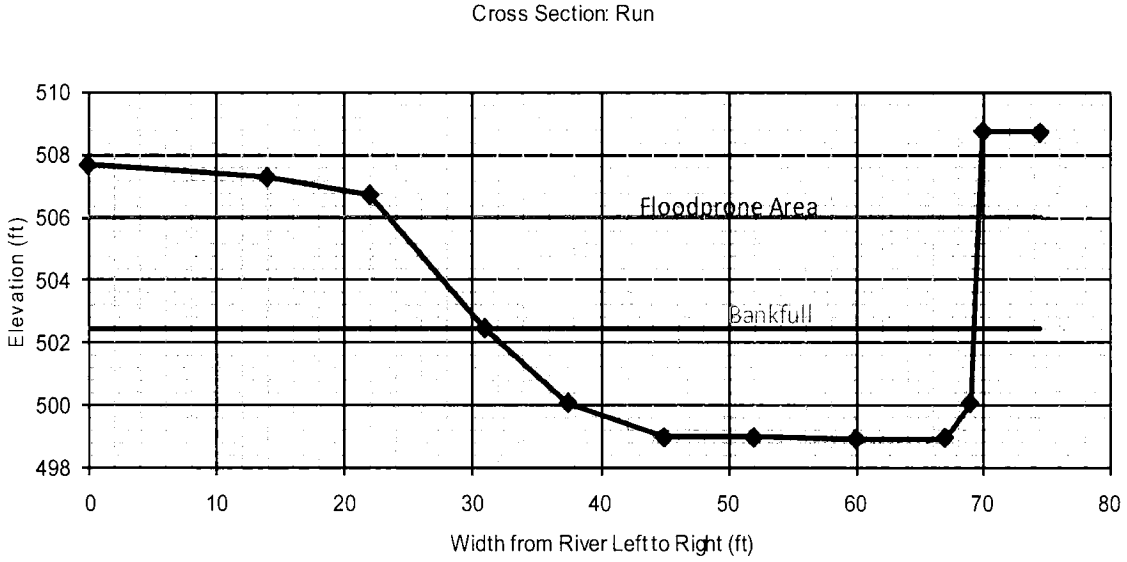


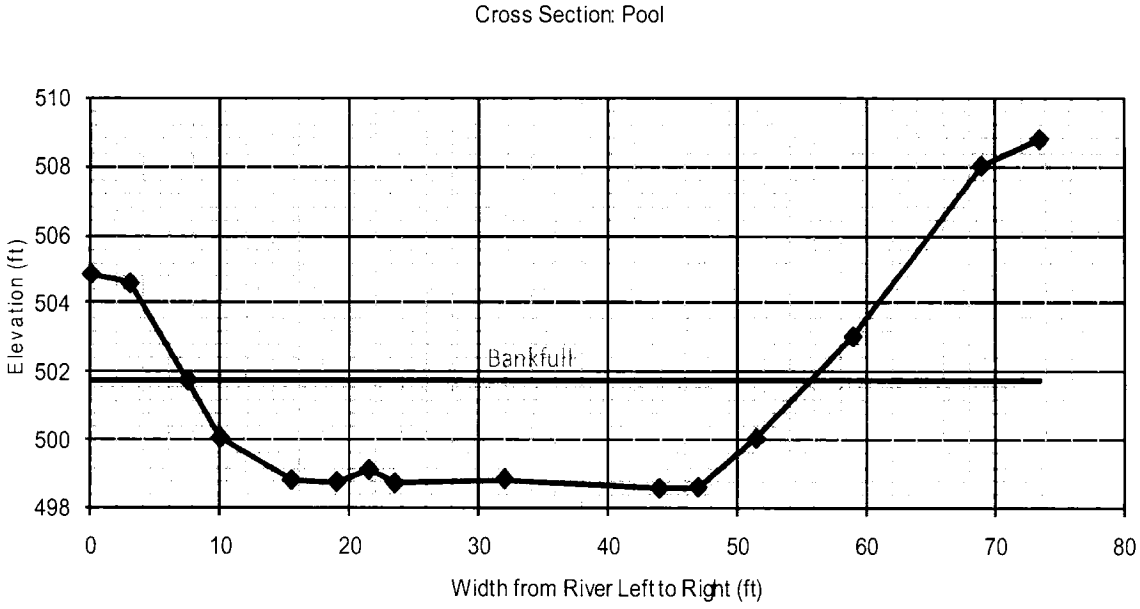
Cross Section: Riffle #3



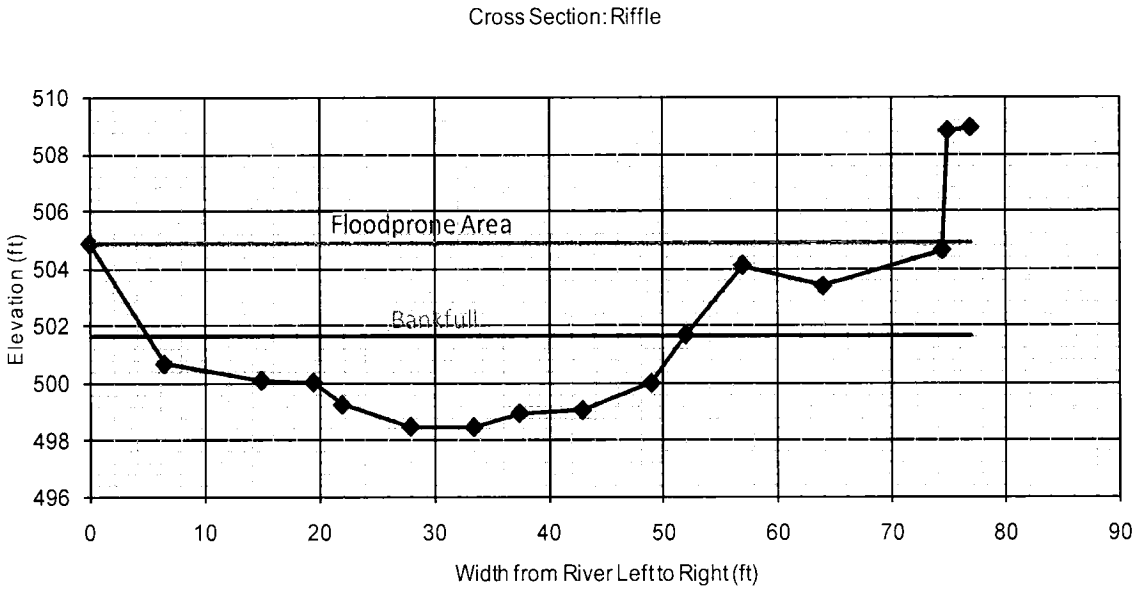
Reach B Cross Sections

An estimated bankfull elevation was determined for Reach B because no bankfull indicators were identified during field surveys.





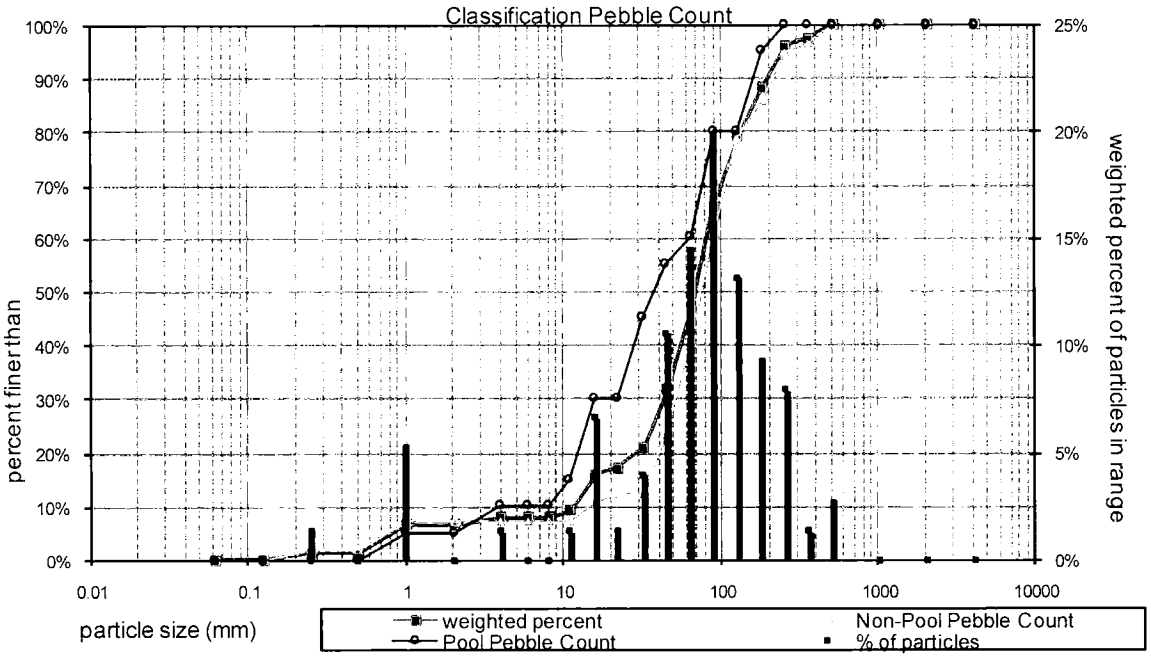
Reach C Cross Section



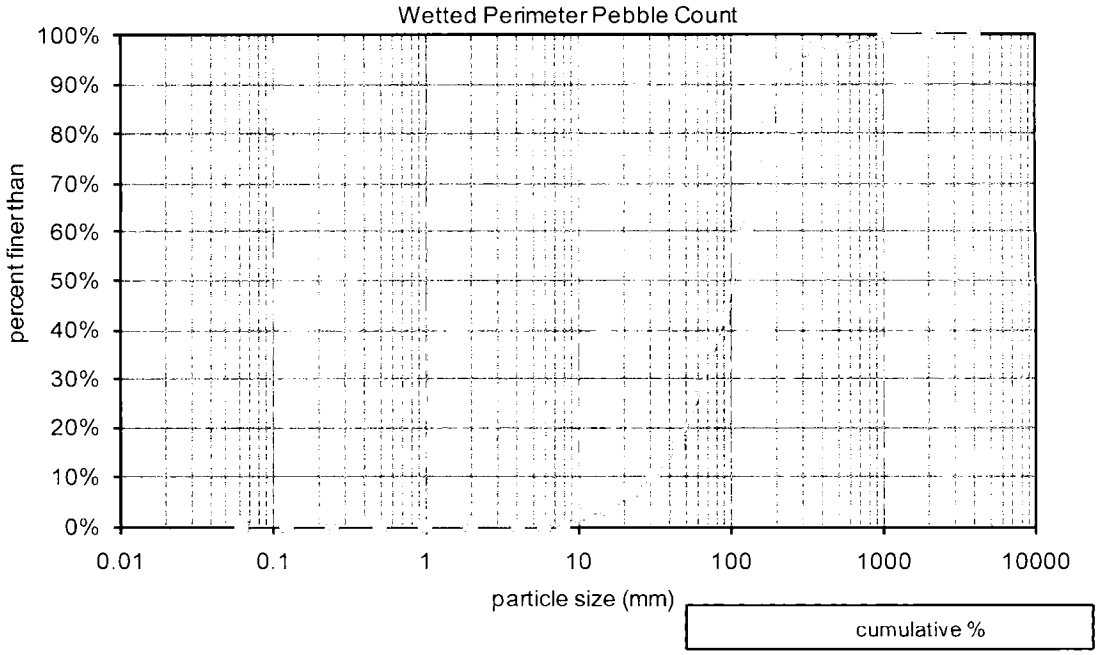
APPENDIX B

Reference Reach Pebble Counts

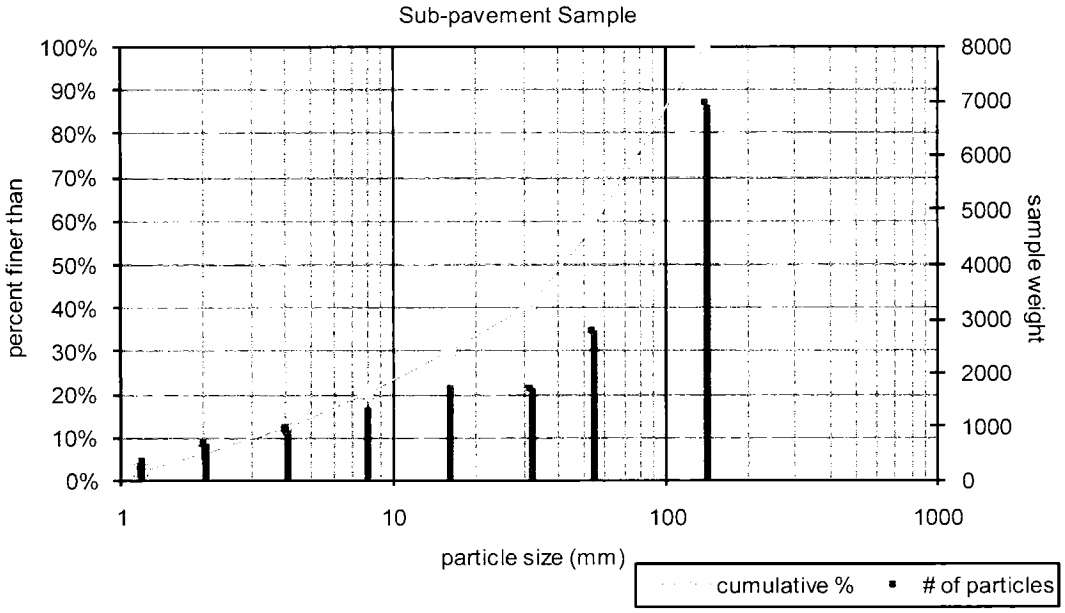
Classification Pebble Count



Wetted Perimeter Pebble Count – Riffle

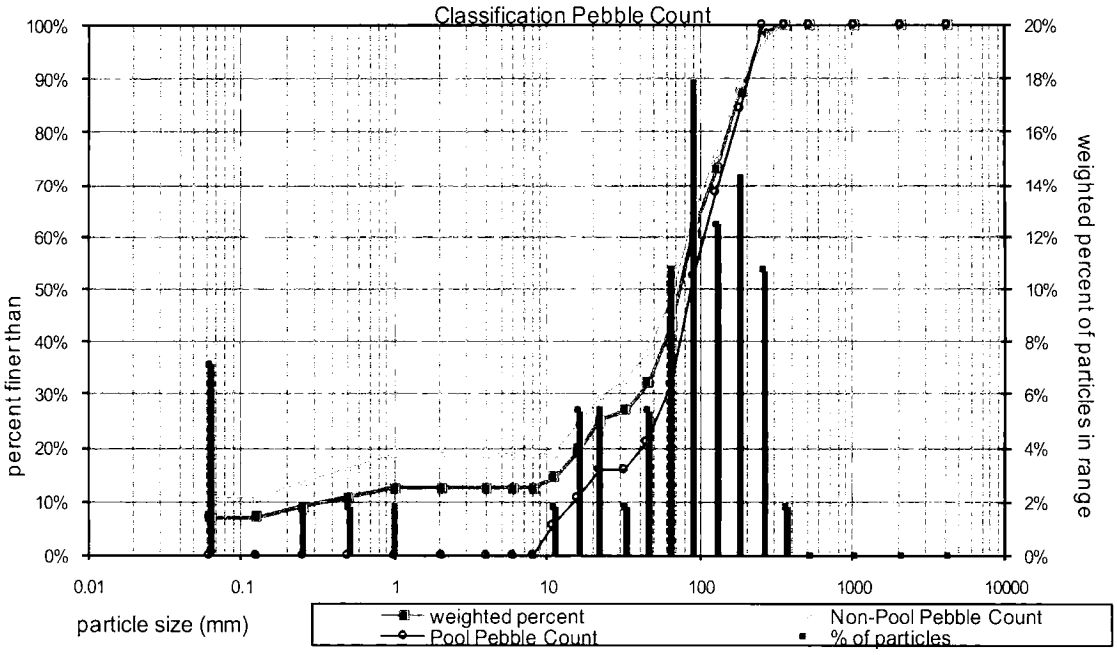


Sub-pavement Sample



Reach C Pebble Count

Classification Pebble Count



APPENDIX C

Photo 1. Riffle at upstream end of Reference Reach.

Photo 2. Reference Reach riffle cross section.

Photo 3. Reference Reach pool.

Photo 4. Mid-channel bar in Reach A.

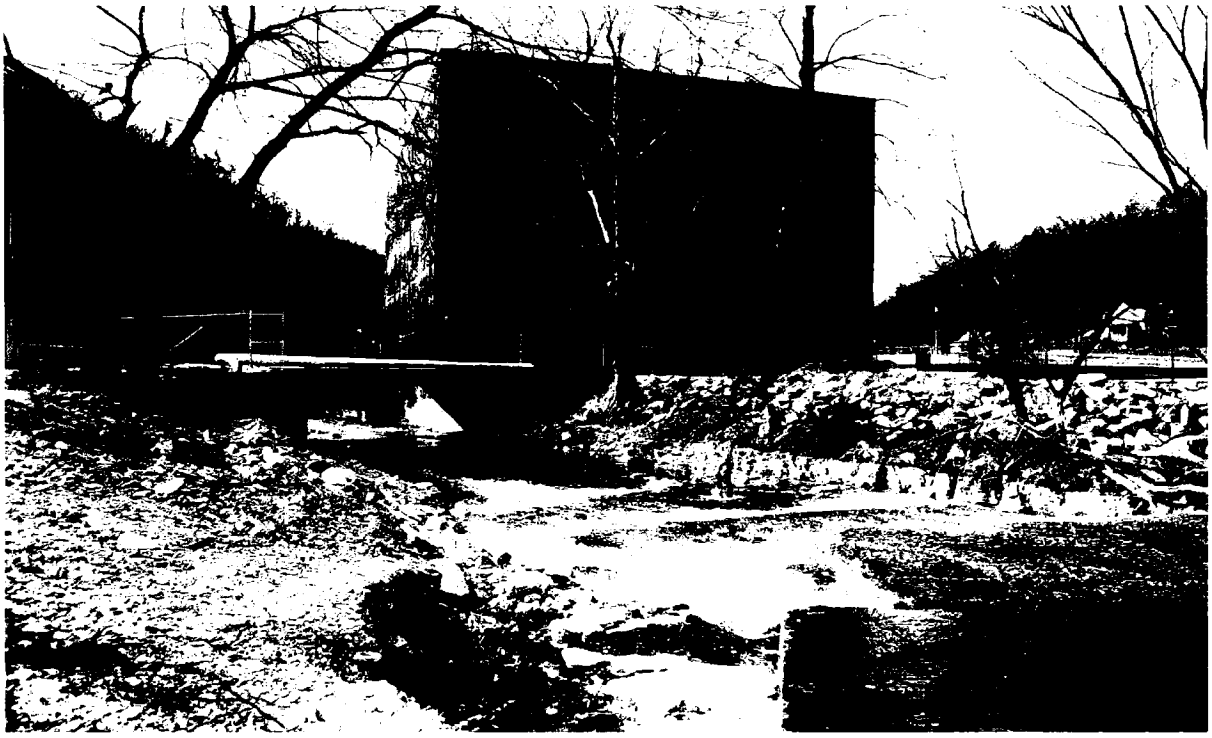


Photo 5. Concrete low-water crossing and exposed bedrock in Reach A. Note bank failure along left streambank.

Photo 6. Reach B looking upstream at the run cross section. Note retaining wall along the right streambank.

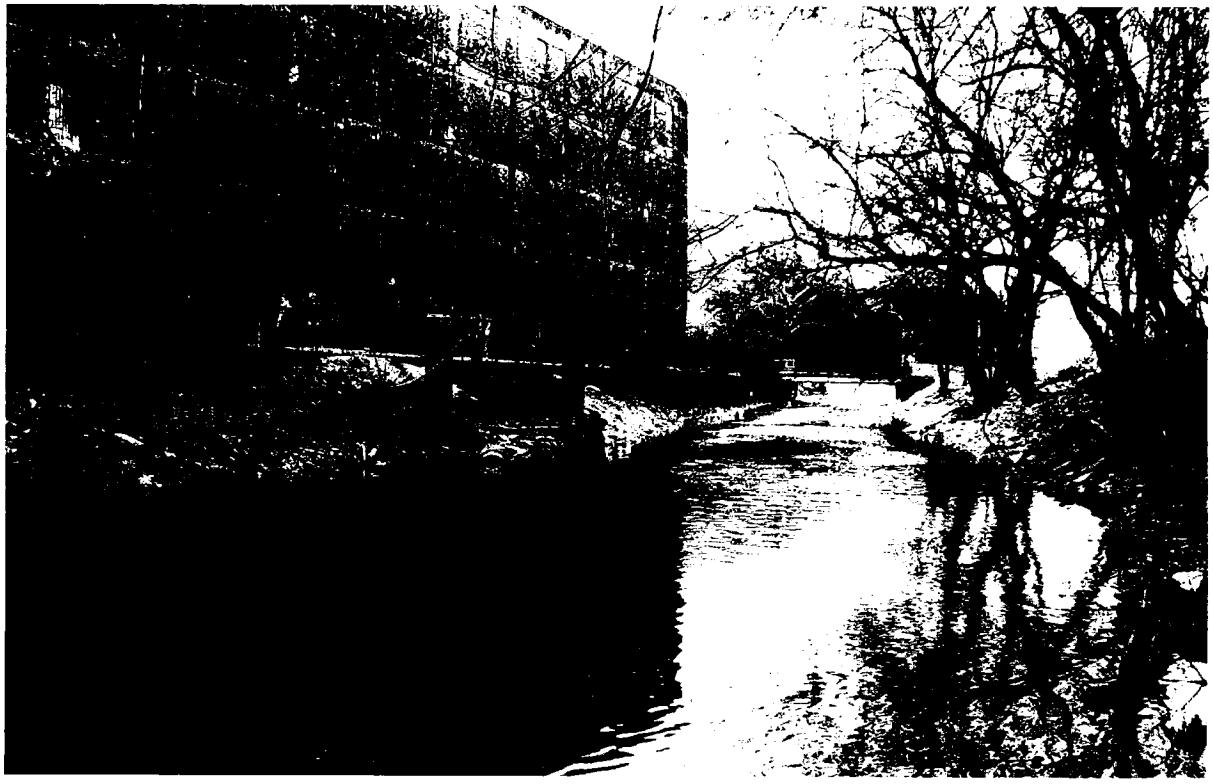


Photo 7. Reach B looking upstream from pool cross section.

Photo 8. Reach C looking downstream from riffle cross section.

APPENDIX D

Morphological Characteristics of the Existing Channel and Reference Reach

Variables	Existing Channel	Reference Reach
Stream Type	F3	F3
Drainage Area, sq. mi.	0.16	0.16
Mean Riffle Depth, ft.	1.9-2.2	2
Width/Depth Ratio	21.5-28.5	30.6
Riffle Cross-Sectional Area, sq. ft.	104-107.3	117.29
Max Riffle Depth, ft.	2.3-2.9	3
Mean Pool Depth, ft.	2.6	3
Pool Width, ft.	48.3	51.5
Pool Cross-Sectional Area, sq. ft.	123.4	154.2
Max Pool Depth, ft.	3.2	3.8
Width of the Floodprone Area,ft.	69-74	78
Entrenchment Ratio	1.3-1.5	1.3
Individual Pool Length, ft.	63	60
Stream Length, ft.	2,200	2,200
Valley Length, ft.	1,757	1,757
Valley Slope	0.009	0.009
Average Water Surface Slope	0.006	0.01
Sinuosity	1.25	1.25
Riffle Slope	0.006	0.021-0.039
Pool Slope	0.003	0.001-0.009
Max Run Depth, ft.	2.6	2.2
Max Glide Depth, ft.	na	3.7
Materials		
Particle Size Distribution of Channel Material (active bed)		
D16(mm)	na	16.62
D35(mm)	na	48.81
D50 (mm)	na	68.5
D84(mm)	na	154
D95(mm)	na	244
Particle Size Distribution of Sub-pavement Material		
D16	na	5.69
D35	na	21.78
D50	na	41.9
D84	na	97
D95	na	124

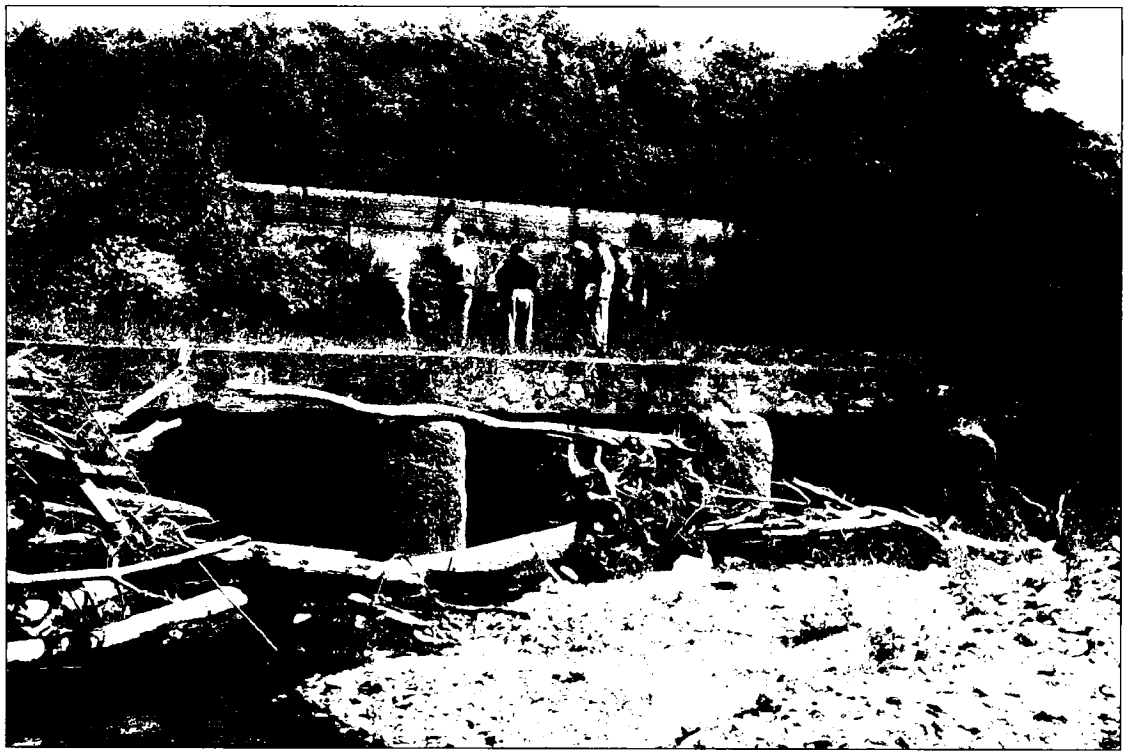
Attachment 6 - Photographs

Glenn's Creek impact reach at the Old Crow low-water crossing (4/14/08)

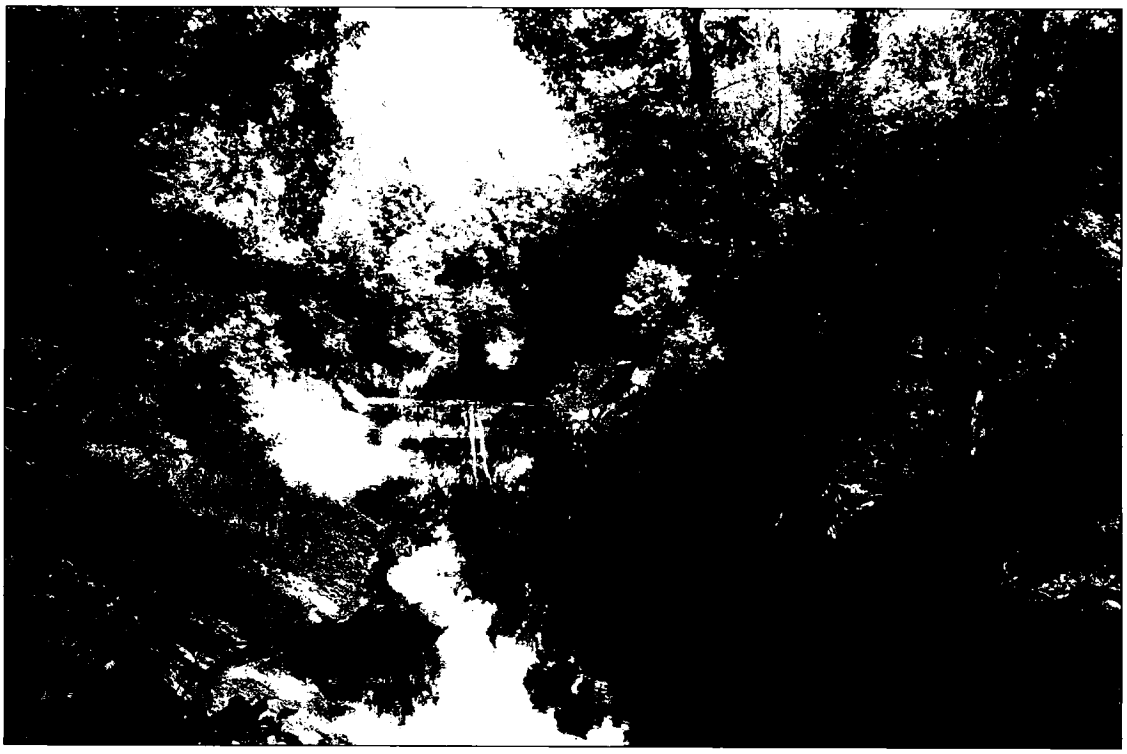
Glenn's Creek impact reach upstream of the low-water crossing (4/14/08)

Old Crow access bridge over Glenn's Creek (4/14/08)

Glenn's Creek cross-channel sediment bar (4/14/08)



Abandoned railroad bridge over Glenn's Creek downstream of the impact reach (8/15/08)



Glenn's Creek preservation area just upstream of the Kentucky River confluence (8/15/08)

Glenn's Creek preservation area near the upper reach boundary (8/15/08)

Attachment 7 - KDOW Habitat Assessment Forms

High Gradient Stream Data Sheet

STREAM NAME: Glenn's Creek	LOCATION: Preservation Area, near KY River Confluence
STATION #: AS-1 MILE: 0.1	BASIN/WATERSHED: Kentucky River
LAT.: 38.152535 LONG.: -84.855856	COUNTY: Franklin
DATE: 8/18/08 TIME: 10:00 X AM PM	INVESTIGATORS: L. Droppelman
TYPE SAMPLE: P-CHEM Macroinvertebrate FISH BACT.	

WEATHER: Now: X Clear/sunny; X Heavy rain, Steady rain, Intermittent showers. Past 24 hours: Has there been a heavy rain in the last 7 days? Yes X No. Air Temperature 70 °F. Inches rainfall in past 24 hours 0 in. 10 % Cloud Cover

P-Chem: Temp(°C)_____ D.O. (mg/l)_____ %Saturation_____ pH(S.U.)_____ Cond._____ Grab

INSTREAM WATERSHED FEATURES:
Stream Width 45 ft
Range of Depth 0.2-6.0 ft
Average Velocity_____ ft/s
Discharge _____ cfs
Est. Reach Length 300 ft

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:

Surface Mining	Construction	X Forest
Deep Mining	Commercial	Pasture/Grazing
Oil Wells	Industrial	Silviculture
Land Disposal	Row Crops	Urban Runoff/Storm Sewers

Hydraulic Structures: Dams, Bridge Abutments, Island, Waterfalls, Other

Stream Flow: Dry, Pooled, X Low, Normal, High, Very Rapid or Torrential

Stream Type: X Perennial, Intermittent, Ephemeral, Seep

Riparian Vegetation: Dominate Type: X Trees, X Shrubs, X Grasses, X Herbaceous. Number of strata 4

Dom. Tree/Shrub Taxa: Am. sycamore, Box elder

Canopy Cover: Fully Exposed (0-25%), Partially Exposed (25-50%), X Partially Shaded (50-75%), Fully Shaded (75-100%)

Channel Alterations: Dredging, Channelization, (Full Partial), None

Substrate **Est.** X P.C.	**Riffle 10 %**	**Run 50 %**	**Pool 40 %**
Silt/Clay (<0.06 mm)	25	34	50
Sand (0.06 – 2 mm)	20	30	30
Gravel (2-64 mm)	35	30	15
Cobble (64–256mm)	18	5	5
Boulders (>256 mm)	2	1	
Bedrock			

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 14	20 19 18 17 16	15 [14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 [11]	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	[10] 9 8 7 6	5 4 3 2 1 0

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 [13] 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 19	20 [19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	[20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[10] 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 [7] 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 [9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 [9]	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	[8] 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank [10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [10] 9	8 7 6	5 4 3	2 1 0

Total Score 150 **NOTES/COMMENTS: Fully Supporting**

STREAM NAME: Glenn's Creek	LOCATION: Preservation Area, near upstream end of 1,800' reach
STATION #: AS-2 MILE: 0.4	BASIN/WATERSHED: Kentucky River
LAT.: 38.148531 LONG.: -84.855856	COUNTY: Franklin
DATE: 8/18/08 TIME: 11:00 X AM PM	INVESTIGATORS: L. Droppelman
TYPE SAMPLE: P-CHEM Macroinvertebrate FISH BACT.	

WEATHER: Now: Heavy rain; Steady rain; Intermittent showers; X Clear/sunny. Past 24 hours: X. Has there been a heavy rain in the last 7 days? Yes X No

Air Temperature 70 °F. Inches rainfall in past 24 hours 0 in. 10 % Cloud Cover

P-Chem: Temp(°C)_____ D.O. (mg/l)_____ %Saturation_____ pH(S.U.)_____ Cond._____ Grab

INSTREAM WATERSHED FEATURES:
Stream Width 60 ft
Range of Depth 0.1-3.5 ft
Average Velocity_____ ft/s
Discharge _____ cfs
Est. Reach Length 300 ft

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:

Surface Mining	Construction	X Forest
Deep Mining	Commercial	Pasture/Grazing
Oil Wells	Industrial	Silviculture
Land Disposal	Row Crops	Urban Runoff/Storm Sewers

Hydraulic Structures: Dams, Bridge Abutments, Island, Waterfalls, Other

Stream Flow: Dry, Pooled, X Low, Normal, High, Very Rapid or Torrential

Stream Type: X Perennial, Intermittent, Ephemeral, Seep

Riparian Vegetation: Dominate Type: X Trees, X Shrubs, X Grasses, X Herbaceous. Number of strata 4. Dom. Tree/Shrub Taxa: Am. sycamore, silver maple

Canopy Cover: Fully Exposed (0-25%); Partially Exposed (25-50%); Partially Shaded (50-75%); X Fully Shaded (75-100%)

Channel Alterations: Dredging, Channelization, (Full Partial), None

Substrate Est. X P.C.	Riffle 30 %	Run 55 %	Pool 15 %
Silt/Clay (<0.06 mm)	2	8	12
Sand (0.06 – 2 mm)	3	10	15
Gravel (2-64 mm)	45	50	40
Cobble (64–256mm)	40	30	25
Boulders (>256 mm)	10	2	8
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 17	20 19 18 [17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 [19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 17	20 19 18 [17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	[15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 [9] 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 [19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 18	20 19 [18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	[8] 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 [9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 [7] 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 [9]	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank [10] 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank [10] 9	8 7 6	5 4 3	2 1 0

Total Score [167] **NOTES/COMMENTS: Fully Supporting**

STREAM NAME: Glenn's Creek	LOCATION: Upstream reach of on-site impact area
STATION #: AS-3 MILE: 1.6	BASIN/WATERSHED: Kentucky River
LAT.: 38.14762 LONG.: -84.83774	COUNTY: Woodford
DATE: 8/18/08 TIME: 9:00 X AM PM	INVESTIGATORS: L. Droppelman
TYPE SAMPLE: P-CHEM Macroinvertebrate FISH BACT.	

WEATHER: Now: X Clear/sunny; Past 24 hours: X Heavy rain / Steady rain / Intermittent showers. Has there been a heavy rain in the last 7 days? Yes X No

Air Temperature 74 °F. Inches rainfall in past 24 hours 0 in. 0 % Cloud Cover

P-Chem: Temp(°C)_____ D.O. (mg/l)_____ %Saturation_____ pH(S.U.)_____ Cond._____ Grab

INSTREAM WATERSHED FEATURES:
Stream Width 40 ft
Range of Depth 0.2-3.0 ft
Average Velocity_____ ft/s
Discharge _____ cfs
Est. Reach Length 300 ft

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:

Surface Mining	Construction	X Forest
Deep Mining	X Commercial	Pasture/Grazing
Oil Wells	Industrial	Silviculture
Land Disposal	Row Crops	Urban Runoff/Storm Sewers

Hydraulic Structures:
Dams Bridge Abutments
Island Waterfalls
Other _____

Stream Flow: Dry Pooled X Low Normal High Very Rapid or Torrential

Stream Type: X Perennial Intermittent Ephemeral Seep

Riparian Vegetation:
Dominate Type: X Trees X Shrubs X Grasses X Herbaceous
Number of strata 4
Dom. Tree/Shrub Taxa: Am. sycamore, box elder

Canopy Cover:
Fully Exposed (0-25%)
Partially Exposed (25-50%)
Partially Shaded (50-75%)
X Fully Shaded (75-100%)

Channel Alterations:
X Dredging
Channelization
(Full Partial) None

Substrate Est. X P.C.	Riffle 15 %	Run 65 %	Pool 20 %
Silt/Clay (<0.06 mm)	5	10	7
Sand (0.06 – 2 mm)	15	15	8
Gravel (2-64 mm)	20	30	5
Cobble (64–256mm)	30	25	5
Boulders (>256 mm)	30	20	5
Bedrock			70

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 [9] 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 13	20 19 18 17 16	15 14 [13] 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 14	20 19 18 17 16	15 [14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 [4] 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[10] 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [6]	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 18	20 19 [18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	[5] 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 [4] 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	[5] 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 [7] 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 [3]	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 [4] 3	2 1 0

Total Score 102 **NOTES/COMMENTS: Not Supporting**

STREAM NAME: Glenn's Creek	LOCATION: Middle reach of on-site impact area
STATION #: AS-4 MILE: 1.5	BASIN/WATERSHED: Kentucky River
LAT.: 38.14696 LONG.: -84.83907	COUNTY: Woodford
DATE: 8/18/08 TIME: 10:30 X AM PM	INVESTIGATORS: L. Droppelman
TYPE SAMPLE: P-CHEM Macroinvertebrate FISH BACT.	

WEATHER: Now: X Clear/sunny; Past 24 hours: X Heavy rain / Steady rain / Intermittent showers. Has there been a heavy rain in the last 7 days? Yes X No

Air Temperature 74 °F. Inches rainfall in past 24 hours 0 in. 0 % Cloud Cover

P-Chem: Temp(°C)_____ D.O. (mg/l)_____ %Saturation_____ pH(S.U.)_____ Cond._____ Grab

INSTREAM WATERSHED FEATURES:
Stream Width 45 ft
Range of Depth 0.1-2.0 ft
Average Velocity_____ ft/s
Discharge _____ cfs
Est. Reach Length 300 ft

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:

Surface Mining	Construction	X Forest
Deep Mining	X Commercial	Pasture/Grazing
Oil Wells	Industrial	Silviculture
Land Disposal	Row Crops	Urban Runoff/Storm Sewers

Hydraulic Structures:
Dams X Bridge Abutments
Island Waterfalls
Other Low-water ford

Stream Flow: Dry Pooled X Low Normal High Very Rapid or Torrential

Stream Type: X Perennial Intermittent Ephemeral Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type: Am. sycamore
X Trees X Shrubs box elder
X Grasses X Herbaceous
Number of strata 4

Canopy Cover:
Fully Exposed (0-25%)
Partially Exposed (25-50%)
X Partially Shaded (50-75%)
Fully Shaded (75-100%)

Channel Alterations:
X Dredging
Channelization
(Full X Partial) None

Substrate Est. X P.C.	Riffle 20 %	Run 70 %	Pool 10 %
Silt/Clay (<0.06 mm)	5	7	5
Sand (0.06 – 2 mm)	5	8	5
Gravel (2-64 mm)	5	15	10
Cobble (64–256mm)	15	15	10
Boulders (>256 mm)	20	5	5
Bedrock	50	50	65

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 3	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 [3] 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles a1re 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 13	20 19 18 17 16	15 14 [13] 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 [9] 8 7 6	5 4 3 2 1 0

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.					Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.					Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.					Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.						
SCORE 7	20	19	18	17	16	15	14	13	12	11	10	9	8	[7]	6	5	4	3	2	1	0		
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.					Water fills >75% of the available channel; or <25% of channel substrate is exposed.					Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.					Very little water in channel and mostly present as standing pools.						
SCORE 15	20	19	18	17	16	[15]	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.						
SCORE 6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	[6]	5	4	3	2	1	0		
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.						
SCORE 14	20	19	18	17	16	15	[14]	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.						
SCORE 4 **(LB)**	Left Bank		10		9		8		7	6		5		[4]	3		2		1		0		
SCORE 2 **(RB)**	Right Bank		10		9		8		7	6		5		4	3		[2]		1		0		
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.						
SCORE 3 **(LB)**	Left Bank		10		9		8		7	6		5		4	[3]		2		1		0		
SCORE 2 **(RB)**	Right Bank		10		9		8		7	6		5		4	3		[2]		1		0		
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.						
SCORE 3 **(LB)**	Left Bank		10		9		8		7	6		5		4	[3]		2		1		0		
SCORE 2 **(RB)**	Right Bank		10		9		8		7	6		5		4	3		[2]		1		0		

Total Score [83] **NOTES/COMMENTS: Not Supporting**

STREAM NAME: Glenn's Creek	LOCATION: Lower reach of on-site impact area
STATION #: AS-5 MILE: 1.4	BASIN/WATERSHED: Kentucky River
LAT.: 38.14571 LONG.: -84.84059	COUNTY: Woodford
DATE: 8/18/08 TIME: 11:00 X AM PM	INVESTIGATORS: L. Droppelman
TYPE SAMPLE: P-CHEM Macroinvertebrate FISH BACT.	

WEATHER: Now: X Clear/sunny; Past 24 hours: X Heavy rain / Steady rain / Intermittent showers / Clear/sunny. Has there been a heavy rain in the last 7 days? Yes X No

Air Temperature 74 °F. Inches rainfall in past 24 hours 0 in. 0 % Cloud Cover

P-Chem: Temp(°C)_____ D.O. (mg/l)_____ %Saturation_____ pH(S.U.)_____ Cond._____ Grab

INSTREAM WATERSHED FEATURES:
Stream Width 45 ft
Range of Depth 0.1-1.5 ft
Average Velocity____ ft/s
Discharge ____ cfs
Est. Reach Length 300 ft

LOCAL WATERSHED FEATUREES:
Predominant Surrounding Land Use:

Surface Mining	Construction	X Forest
Deep Mining	X Commercial	Pasture/Grazing
Oil Wells	Industrial	Silviculture
Land Disposal	Row Crops	Urban Runoff/Storm Sewers

Hydraulic Structures:
Dams X Bridge Abutments
Island Waterfalls
Other Retaining walls

Stream Flow: Dry Pooled X Low Normal High Very Rapid or Torrential

Stream Type: X Perennial Intermittent Ephemeral Seep

Riparian Vegetation:
Dominate Type: X Trees X Shrubs X Grasses X Herbaceous
Number of strata 4
Dom. Tree/Shrub Taxa: Am. sycamore, box elder

Canopy Cover:
Fully Exposed (0-25%)
X Partially Exposed (25-50%)
Partially Shaded (50-75%)
Fully Shaded (75-100%)

Channel Alterations:
X Dredging
Channelization
(X Full Partial) None

Substrate Est. X P.C.	Riffle 70 %	Run 25 %	Pool 5 %
Silt/Clay (<0.06 mm)	5	5	5
Sand (0.06 – 2 mm)	5	5	15
Gravel (2-64 mm)	25	40	30
Cobble (64–256mm)	50	35	35
Boulders (>256 mm)	15	15	10
Bedrock			5

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 [11]	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles a1re 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 13	20 19 18 17 16	15 14 [13] 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 [9] 8 7 6	5 4 3 2 1 0

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	[5] 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 [8] 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 [4] 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 16	20 19 18 17 [16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 [3]	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 [6]	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	[2] 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	[2] 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 [3]	2 1 0
SCORE 1 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [1] 0

Total Score [82] **NOTES/COMMENTS: Not Supporting**

Attachment 8 - Draft Deed Restriction

DECLARATION OF COVENANTS, CONDITIONS, AND RESTRICTIONS

THIS DECLARATION OF COVENANTS, CONDITIONS, AND RESTRICTIONS (this "Declaration") is made this ___ day of_____, 2008, by the Jim Beam Brands Co., a Delaware corporation, having an address at [510 Lake Cook Rd., Ste. 200 Deerfield, IL 60015-4619] ("Declarant").

RECITALS:

A. Declarant is the owner in fee simple of certain real property (the "Restricted Property") located at the confluence of Glenn's Creek and the Kentucky River in Franklin County, Kentucky, and more particularly described on Exhibit A attached hereto and incorporated herein.

B. The Restricted Property consists, in part, of an eighteen hundred (1,800) foot linear corridor of the mainstem of Glenn's Creek, a perennial Kentucky River tributary, and adjacent riparian area. The corridor width is one hundred and fifty (150) feet wide and is comprised of an average ordinary high water stream channel width of fifty (50) feet and an additional zone extending laterally from both the left and right ordinary high water marks for a distance of fifty (50) feet on each side of Glenn's Creek. Thus the Restricted Property contains the channel active bed, the ordinary high water limits and riparian corridor. In particular, the Restricted Property represents high quality aquatic and riparian habitat in the Kentucky River/Glenn's Creek watershed in Franklin County. The values related to the Restricted Property's natural, scenic, riparian, wetland, and open-space characteristics have been documented in an inventory of relevant features compiled by Eco-Tech Consultants, Inc dated _____, and are hereinafter collectively referred to as the "Conservation Values," which are of great importance to Declarant, the people of Franklin County, Kentucky, and the people of the Commonwealth of Kentucky. A copy of such inventory has been provided to the Kentucky Division of Water ("KDOW"), an agency of Kentucky's Energy and Environment Cabinet (formerly known as the Environmental and Public Protection Cabinet) and the United States Corps of Engineers.

C. Declarant is the recipient of Department of Army Permit No. _____, dated _____(the "Department of the Army Permit") and that certain Water Quality Certification #_____ (the "WQC") issued by KDOW. The Department of the Army Permit and the WQC are hereinafter collectively referred to as the "Permits."

D. The Permits were issued in connection with activities on that certain jurisdictional waterway located upstream from the Restricted Property along Glenn's Creek and also owned by Declarant (the "Affected Corridor"), as set forth in Declarant's applications for the Permits.

E. On or before the date hereof, Declarant has submitted its "Final Mitigation Plan – _____– USACE ID No. _____– KDOW AI No. _____" dated _____ (the "Mitigation Plan"), to the U.S. Army Corps of Engineers ("USACE") and to KDOW in connection with the Permits.

F. Declarant, USACE, and KDOW have reached an agreement whereby Declarant's actions at the Affected Corridor shall be allowed in accordance with the terms and conditions of the Permits, and Declarant shall mitigate the adverse environmental effects resulting therefrom in part by permanently protecting the Restricted Property by establishing a buffer on each side of Glenn's Creek from the point where it joins the Kentucky River for approximately eighteen hundred (1,800) linear feet. In particular, Declarant has agreed to dedicate the Restricted Property for the perpetual use as a protected riparian buffer area in accordance with the terms and conditions of this Declaration and the Permits.

F. A permit to place fill or otherwise cause an adverse impact to the Affected Corridor would not have been granted by USACE and KDOW but for the dedication of the Restricted Property for riparian buffer purposes, and Declarant specifically acknowledges that the Permits are issued in consideration for the execution and recording of this Declaration and compliance with the covenants and deed restrictions herein.

NOW THEREFORE, Declarant, for and in consideration of the facts recited above and other good and valuable consideration hereby acknowledged, hereby declares that the Restricted Property hereinafter shall be bound by, held, transferred, sold, conveyed, used, improved, leased, hypothecated, and/or occupied subject to the terms and conditions of this Declaration, all of which shall be perpetual and run with the land and shall be binding on all persons, firms, associations, corporations, or governmental entities having or hereafter acquiring any right, title or interest in the Restricted Property, or any part thereof; and Declarant enters into the following covenants and deed restrictions on behalf of itself and its successors and assigns:

1. **Purpose.** It is the purpose of this Declaration to assure that the Restricted Property will be retained forever in its existing natural condition and to prevent any use of the Restricted Property that will impair or interfere with the Conservation Values of the Restricted Property. Declarant intends that this Declaration will confine the use of the Restricted Property to such activities as are not inconsistent with the purpose of this Declaration

2. **Declarant's Covenants.** Declarant shall make reasonable efforts to minimize dumping and trespassing on the Restricted Property and in Glenn's Creek. Declarant may, but shall not be obligated to, install and maintain fencing along the boundary of the Restricted Property in the event Declarant determines in its reasonable discretion that dumping and trespassing are not being sufficiently prevented at the Restricted Property. Such fencing may also be installed to keep out livestock and domestic animals and may be installed for the protection or enhancement of the Restricted Property. Such fencing shall not obstruct human access to the Restricted Property for monitoring and other purposes contemplated in the Permits.

3. **Prohibited Uses.** Any activity on or use of the Restricted Property inconsistent with the purpose of this Declaration is prohibited. Without limiting the generality of the foregoing, and in furtherance of the restrictions herein set forth, Declarant and its successors and assigns agree to each of the following prohibitions, subject to the noted exceptions and limitations, which prohibitions contribute to the public purpose of significantly protecting and preserving the Restricted Property and protecting the Conservation Values:

(a) The legal or de facto division, subdivision, or partitioning of the Restricted Property is prohibited. Any transfer of the fee interest in the Restricted Property shall be of the entire Restricted Property as a single parcel.

(b) Any agricultural, residential, commercial, or industrial use of or activity on the Restricted Property is prohibited.

(c) The placement, construction, or maintenance of any buildings, structures, or other improvements of any kind, including, without limitation, fences (except as expressly permitted in **Section 2**), roads, parking lots, radio towers, towers for cellular telecommunications, and utility transmission lines and related facilities, above or below the ground, is prohibited.

(d) Any alteration of the surface of the land, including, without limitation, filling, mining, drilling, or the excavation or removal of soil, sand, gravel, rock, peat, or sod, without the prior written approval of KDOW and USACE, is prohibited, except for potential habitat improvements and buffering activities pursuant to the Permits or otherwise required by KDOW and USACE.

(e) Any use or activity that causes or is likely to cause significant soil degradation or erosion or significant depletion or pollution of any surface or subsurface waters is prohibited, except for the discharge of storm water directly or through a conveyance from an adjacent property pursuant to any permit, license, or approval issued to Declarant by an appropriate local, state, or federal governmental agency and in conformance with the Permits or other wetland restoration, creation, and enhancement plan approved by KDOW and USACE. In the event Declarant makes application for such permit, license, or approval, Declarant shall notify KDOW's Water Quality Branch in writing of such application made to an issuing authority.

(f) The diverting or affecting of the natural flow of Glenn's Creek or other surface or underground waters within, or out of, the Restricted Property, and the draining, filling, dredging, or diking of Glenn's Creek, including any enlargement thereof, or the cultivation or other disturbance of the soil are prohibited, except in conformance with the Permits or other wetland restoration, creation, and enhancement plan approved by KDOW and USACE.

(g) The alteration or manipulation of water courses and wells, if any, located on the Restricted Property, or the creation of new water impoundments, water courses, or wells for any purpose is prohibited, except in conformance with the Permits or other wetland restoration, creation, and enhancement plan approved by KDOW and USACE.

(h) The clearing, cutting, or mowing of natural growth or the burning, harvesting, destruction, or removal of trees is prohibited, except as specifically permitted in **Section 4(a)** of this Declaration.

(i) The installation of underground storage tanks or the processing, storage, dumping, placing, or disposal of wastes, sewage, dredged spoil, solid waste, incinerator residue, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, or agricultural waste on the Restricted Property is prohibited.

(j) The placement of any signs or billboards on the Restricted Property is prohibited, except as expressly permitted in **Section 4(b)**.

(k) The construction of new roads or the paving of any existing unpaved road or trail is prohibited.

(l) The use of motorized recreational vehicles on the Restricted Property, including, but not limited to, snow mobiles and all-terrain vehicles is prohibited.

(m) Any hunting, fishing, or trapping of animals for sport or consumption is prohibited. This **Section 3(m)** does not apply to any actions taken to contain or control wildlife populations or overpopulation in accordance with a wildlife management plan, as set forth in **Section 4(d).**

(n) The application or use of biocides, herbicides, or pollutants that violate water quality standards is prohibited.

(o) Introducing exotic species on the Restricted Property is prohibited.

(p) Recreational horseback riding, whether on or off an established trail, is prohibited.

(q) The grazing, pasturing, or keeping of cattle, sheep, horses or other livestock on the Restricted Property is prohibited.

(r) Any unanticipated activity or use of the Restricted Property which is inconsistent with the purpose of this Declaration is prohibited unless such use or activity is necessary for the protection of the Conservation Values that are the subject of this Declaration, in which case such use or activity shall be subject to the prior approval of USACE or KDOW as provided in **Section 11** herein.

4. **Reserved Rights.** Declarant reserves to itself, and to its successors and assigns, all rights accruing from their ownership of the Restricted Property, including the right to engage in, or permit or invite others to engage in, all uses of the Restricted Property that are not expressly prohibited herein and are not inconsistent with the purpose of this Declaration. Without limiting the generality of the foregoing, the following rights are expressly reserved:

(a) The right to selectively prune or cut trees or selectively remove vegetation on the Restricted Property, but only as necessary for fire prevention, elimination of diseased growth, or control of invasive, non-native species; to control insects and disease; or to prevent personal injury or property damage; and if applicable and available, in accordance with best management practices recommended by the Kentucky Division of Forestry or successor agency;

(b) The right to install signs, the placement, number, and design of which do not significantly diminish the scenic character of the Restricted Property, for the following purposes: to state the name and address of the Restricted Property and the name of owners of the Restricted Property, to advertise the Restricted Property for sale or rent, to post the Restricted Property against trespass or to otherwise control unauthorized entry or use, and to give notice of the significance of the Restricted Property;

(c) The right to lease or grant other less-than-fee interests in the Restricted Property for any use permitted to Declarant under this Declaration, provided that such lease or other interest is consistent with and subject to the terms of this Declaration; and

(d) The right to develop and implement a wildlife management plan in consultation with the Commonwealth of Kentucky Department of Fish and Wildlife Resources, with other agencies of the Commonwealth of Kentucky, and/or with environmental consultants to address animal population and habitat improvement if deemed necessary by Declarant, which plan may include trapping, fishing, and other lawful methods of controlling wildlife populations and overpopulation.

5. **Amendment and Recording.** Any amendment to this Declaration shall be consistent with the purpose of this Declaration and shall be subject to the prior written approval of Declarant, USACE, and KDOW. Declarant shall record this Declaration and any subsequent amendments in the official records of the Office of the Franklin County Clerk within thirty (30) days of execution by Declarant, USACE, and KDOW, and shall, no later than thirty (30) days after the date of recording, provide USACE and KDOW with a copy of the recorded Declaration and any amendments and exhibits thereto. Declarant, USACE, or KDOW may re-record this Declaration at any time as may be required to preserve their respective rights.

6. **Enforcement.** USACE and KDOW shall have the right to enforce by proceedings in law or equity the covenants and deed restrictions set out herein, and this right shall not be waived by one or more incidents of failure to enforce said right. Appropriate remedy for violation of this Declaration is contemplated to include, without limitation, injunctive relief to restrain such violation or require restoration caused by such violation, administrative, civil, or criminal penalties, if available and applicable on the date hereof, and any other remedy available under law or equity. No violation of this Declaration shall result in a forfeiture or reversion of title. Lost Conservation Values shall not be required to be replaced if the loss is due to acts of God, natural disasters, or acts of third parties outside the control of Declarant. Failure to timely enforce compliance with this Declaration or the prohibitions contained herein by any party shall not bar subsequent enforcement by such party and shall not be deemed a waiver of that party's right to take action to enforce any non-compliance.

7. **Access.** Employees, agents, and contractors of USACE or KDOW shall have the right to view and inspect the Restricted Property in its natural, scenic, and open-space condition and the right to enter the Restricted Property for the purpose of inspecting the Restricted Property to determine if Declarant, or its successors or assigns, is complying with the covenants and deed restrictions herein. To facilitate the exercise of the foregoing rights, Declarant grants to USACE, KDOW, and their employees, agents, and contractors the right of access, ingress, and egress by easement over, on, and through Declarant's adjacent property on private access roads and/or pedestrian access from the nearest vehicular access point as depicted on the plat of survey shown on Exhibit B attached hereto.

8. **Perpetual Nature; Successors and Assigns.** The terms and conditions of this Declaration shall, as of the date of execution of this Declaration, bind Declarant to the extent of its equitable interest in the Restricted Property, and this Declaration and the restrictions and covenants set forth herein shall run with the land and be binding on Declarant and its successors

and assigns forever. All references to USACE and KDOW shall include successor governmental agencies, departments, or divisions, or any other successor entities prescribed by law.

9. **Subsequent Transfers**. Any transfer, conveyance, or encumbrance affecting the Restricted Property shall set forth the terms and conditions of this Declaration either by reference to this Declaration and its recorded location or by attachment and incorporation by reference.

10. **Notice of Transfers and Legal Action.**

(a) Declarant shall notify KDOW and USACE in writing of any legal action affecting title to all or a portion of the Restricted Property, including, but not limited to, the exercise of the power of eminent domain.

(b) Declarant shall notify USACE and KDOW at least thirty (30) days in advance of any proposed grant, transfer, or conveyance of any interest in any or all of the Restricted Property. Such notice shall include the name, address, and telephone number of the prospective transferee and a copy of the proposed deed or other documentation evidencing the conveyance.

11. **Notice and Approvals.**

(a) **Notice of Intention to Undertake Certain Permitted Actions**. The purpose of requiring approval by KDOW and USACE prior to undertaking certain activities is to afford USACE and KDOW an adequate opportunity to review proposed activities in question to ensure that they are designed and carried out in a manner that is not inconsistent with the purpose of this Declaration and the Permits. Whenever such approval is required, Declarant shall notify KDOW and USACE in writing not less than thirty (30) days prior to the date Declarant intends to undertake the activity in question. The notice shall describe the nature, scope, design, location, timetable, and any other material aspect of the proposed activity in sufficient detail to permit KDOW and USACE to make an informed judgment as to its consistency with the purpose of this Declaration and the Permits.

(b) **USACE and KDOW Approval.** Where approval of USACE and KDOW is required under the terms of this Declaration, approval shall be granted or withheld in writing within thirty (30) days of receipt of Declarant's written request therefor. Approval may be withheld only upon a determination by KDOW or USACE that the action as proposed would be inconsistent with the purpose of this Declaration or would undermine the purposes of Section 404 (in the case of USACE) or Section 401 (in the case of KDOW) of the Clean Water Act. The failure of USACE or KDOW to respond within said period shall constitute the grant of permission by USACE or KDOW, as applicable, with respect to the subject request. KDOW and USACE shall be guided by the purpose of this Declaration, the Conservation Values, and statutory and regulatory authority under the Clean Water Act, in rendering their respective decisions. In the case of withholding of approval, KDOW and USACE shall notify Declarant in writing with reasonable specificity of the reasons for such denial, and the conditions, if any, on which approval might otherwise be given.

(c) **Notice.** All notices required to be given pursuant to this Declaration shall be sent to the following addresses, by certified mail, or to such other address as may be subsequently designated in writing by the respective party:

If to Declarant:	Jim Beam Brands Co. Attention:_____ 510 Lake Cook Rd., Ste. 200 Deerfield, Illinois 60015-4619 Facsimile:_____
With Copy To:	Stites & Harbison, PLLC Attention: W. Patrick Stallard 400 West Market Street, Suite 1800 Louisville, Kentucky 40202 Facsimile: (502) 587-6391
If to USACE:	U.S. Army Corps of Engineers Louisville District P.O. Box 59 Louisville, Kentucky 40201-0059
If to KDOW:	Energy and Environment Cabinet Division of Water 14 Reilly Road Frankfort, Kentucky 40601

12. **Severability**. If any provision of this Declaration, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this Declaration, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

13. **Future Mitigation.** In the event that Declarant, or its successors and assigns as owner of the Restricted Property, undertake activities at the Restricted Property which violate the terms of this Declaration and would require wetlands mitigation under Sections 401 and 404 of the Clean Water Act and their implementing regulations, then such owner of the Restricted Property shall be responsible for providing conservation mitigation in such amounts and of such value and function as USACE and KDOW shall determine in accordance with Sections 401 and 404 of the Clean Water Act and their implementing regulations.

IN WITNESS WHEREOF, Declarant has set its hands on the day and year first above written.

DECLARANT:

JIM BEAM BRANDS CO., a Delaware corporation

BY: _____

Printed Name:_____

Title:_____

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF JEFFERSON)

The foregoing instrument was acknowledged before me by _____ _____, the _____ of Jim Beam Brands Co., a Delaware corporation, this ___ day of _____, 2008, on behalf of the Corporation.

My commission expires:_____

_____
Notary Public, State at Large
Kentucky

Acknowledgment:

The Commonwealth of Kentucky's Energy and Environment Cabinet, Division of Water acknowledges and agrees that the foregoing instrument meets the requirements of the Department of the Army Permit and the WQC and acknowledges and agrees to the rights set forth in the foregoing instrument:

Energy and Environment Cabinet
Division of Water

BY: _____

Name: _____

Title: _____

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF_____)

The foregoing instrument was acknowledged before me by _____, as _____ of the Commonwealth of Kentucky's Energy and Environment Cabinet, Division of Water this ___ day of _____, 2008.

My commission expires:_____

_____
Notary Public, State at Large
Kentucky

Acknowledgment:

U.S. Army Corps of Engineers, Louisville District acknowledges and agrees that the foregoing instrument meets the requirements of the Department of the Army Permit and the WQC and acknowledges and agrees to the rights set forth in the foregoing instrument:

U.S. Army Corps of Engineers
Louisville District

BY: _____

Name: _____

Title: _____

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF JEFFERSON)

The foregoing instrument was acknowledged before me by _____, as _____ of U.S. Army Corps of Engineers, Louisville District this ___ day of _____, 2008.

My commission expires:_____

_____
Notary Public, State at Large
Kentucky

THIS INSTRUMENT PREPARED BY:

_____
Monica E. Henderson, Esq.
STITES & HARBISON
400 West Market Street
Suite 1800
Louisville, Kentucky 40202-3352
Telephone: (502) 587-3400

Preliminary Draft
9/2/2008

Exhibit A
Legal Description

Centerline of Glenn's creek from confluence with KY River, for approx. 1,800 linear feet, with buffer 50 feet from high water mark or 75 feet on each side of centerline, as described and exhibited in the Mitigation Plan (Actual surveying of the centerline and Restricted Property to be completed by a Professional Land Surveyor upon Department of the Army Permit and WQC application approval).

Exhibit B

Plat of Survey – showing restricted area, and
Showing access points/easement grant from adjoining land.

Attachment 9 - U.S. Fish and Wildlife Service Early Coordination Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

July 25, 2008

Mr. Lee Droppleman
Eco-Tech
102 W. Court Avenue
Jeffersonville, Indiana 47130

Subject: FWS 2008-B-0804; Glenn's Creek Stream Restoration Project, Woodford County, Kentucky

Dear Mr. Droppleman:

Thank you for you correspondence of July 25, 2008, requesting a species list for the Glenn's Creek stream restoration activities at the Jim Beam Brands Old Crow Facility in Woodford County, Kentucky. The project would entail stream bank and bed modifications along an approximate 1800-foot reach. Additionally, select riparian trees may need to be removed and the immediate floodplain may be graded and shaped to facilitate natural stream channel design. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and we offer the following comments.

Additionally, summer roost and/or winter habitat for the endangered Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) may exist within the proposed project sites. Based on this information, we believe that: (1) forested areas in the vicinity of and on the project area may provide potentially suitable summer roosting and foraging habitat for the Indiana bat and potentially suitable foraging habitat for the gray bat (if suitable roosting sites are present); and (2) caves, rockshelters, and abandoned underground mines in the vicinity of and on the project area may provide potentially suitable winter hibernacula habitat for the Indiana bat and/or potentially suitable summer roosting and winter hibernacula habitat for the gray bat. Our belief that potentially suitable habitat may be present, and possibly occupied by one or both of these species, is based on the information provided in your correspondence, the fact that much of the project site and surrounding areas contain forested habitats that are within the natural ranges of these species, and our knowledge of the life history characteristics of these species. The Indiana bat utilizes a wide array of forested habitats, including riparian forests, bottomlands, and uplands for both summer foraging and roosting habitat. Indiana bats typically roost under exfoliating bark, in cavities of dead and live trees, and in snags (i.e., dead trees or dead portions of live trees). Trees in excess of 16 inches diameter at breast height (DBH) are considered optimal for maternity colony roosts, but trees in excess of 9 inches DBH appear to provide suitable maternity

roosting habitat. Male Indiana bats have been observed roosting in trees as small as 3 inches DBH.

Prior to hibernation, Indiana bats utilize the forest habitat around the hibernacula, where they feed and roost until temperatures drop to a point that forces them into hibernation. This "swarming" period lasts, depending on weather conditions in a particular year, from about September 15 to about November 15. This is a critical time for Indiana bats, since they are acquiring additional fat reserves and mating prior to hibernation. Research has shown that bats exhibiting this "swarming" behavior will range up to ten miles from chosen hibernacula during this time. For hibernation, the Indiana bat prefers limestone caves, sandstone rockshelters, and abandoned underground mines with stable temperatures of 39 to 46 degrees F and humidity above 74 percent but below saturation.

Gray bats roost, breed, rear young, and hibernate in caves year round. They migrate between summer and winter caves and will use transient or stopover caves along the way. For hibernation, the roost site must have an average temperature of 42 to 52 degrees F. Most of the caves used by gray bats for hibernation have deep vertical passages with large rooms that function as cold air traps. Summer caves must be warm, between 57 and 77 degrees F, or have small rooms or domes that can trap the body heat of roosting bats. Summer caves are normally located close to rivers or lakes where the bats feed. Gray bats have been known to fly as far as 12 miles from their colony to feed. Additional, habitat and life history information on these species is available on the Service's national website at www.fws.gov.

Because we have concerns relating to these species on this project and due to the lack of occurrence information available on these species relative to the proposed project area, we have the following recommendations relative to Indiana bats and gray bats.

2) Based on the presence of numerous caves, rockshelters, and underground mines in eastern Kentucky, we believe that it is reasonable to assume that other caves, rockshelters, and/or abandoned underground mines may occur within the project area, and, if they occur, they could provide winter habitat for Indiana bats and/or summer and winter habitat for the gray bat. Therefore, we recommend that you survey the project area for caves, rockshelters, and underground mines, identify any such habitats that may exist on-site, and avoid impacts to those sites pending an analysis of their suitability as Indiana bat habitat by this office.

3) We also recommend that you only remove trees within the project area between October 15 and March 31 in order to avoid impacting summer roosting Indiana bats. However, if any Indiana bat hibernacula are identified on the project area or are known to occur within 10 miles of the project area, we recommend you only remove trees between November 15 and March 31 in order to avoid impacting Indiana bat "swarming" behavior.

We request your written acceptance of these recommendations as project conditions. However, if these recommendations cannot be incorporated as project conditions, then you should survey the project area to determine the presence or absence of these species within the project area in

an effort to determine if potential impacts to these species are likely. A qualified biologist who holds the appropriate collection permits for these species must undertake such surveys, and we would appreciate the opportunity to review all survey results, both positive and negative. If any Indiana bats and/or gray bats are identified, we request written notification of such occurrence(s) and further coordination and consultation with you. Surveys would not be necessary if sufficient site-specific information was available that showed: (1) that there is no potentially suitable habitat within the project area or its vicinity or (2) that the species would not be present within the project area or its vicinity due to site-specific factors. Please provide us with a written justification or explanation if any of these situations would apply to the proposed project.

Additionally, the federally listed running buffalo clover (*Trifolium stoloniferum*), Braun's rock cress (*Arabis perstellata)*, and Globe bladderpod (*Lesquerella globosa*) may occur in the vicinity of the project area. The applicant should survey the project area to determine the presence or absence of these species within the project area in an effort to determine if potential impacts to these species are likely. A qualified botanist, and preferably one who holds the appropriate collection permits for these species, must undertake such surveys, and we would appreciate the opportunity to approve the biologist's survey plan prior to the survey being undertaken and to review all survey results, both positive and negative. If these species are identified, we request written notification of such occurrence(s) and further coordination and consultation with you.

Thank you for the opportunity to comment on this proposed action. If you have any questions regarding the information which we have provided, please contact Mindi Lawson at (502)/695-0468.

Sincerely,

Virgil Lee Andrews

Virgil Lee Andrews, Jr.
Field Supervisor

Attachment 10 - List of Adjacent Property Owners

Landowners Adjacent to the Jim Beam Old Crow Property

Includes the warehouse facility, contiguous property, and abutting parcels

Source: Franklin and Woodford County Property Valuation Assessors' Offices, August 20, 2008

Owner's Name	Street/P.O. Box	City	State	Zip Code
Rev Heart Pine, LLC	348 Hempstead Place	Charlotte	NC	28207
The National Audubon Society	700 Broadway	New York	NY	10003
Charles & Louise Shyrock	3246 Glenns Creek Road	Frankfort	KY	40601
Whitehat, LLC	122 Valleybrook Drive	Frankfort	KY	40601
William and Tia Edwards and Sataysha Riggs	2660 Glenns Creek Road	Frankfort	KY	40601
William E. Charlton, IV	701 Johnson Road	Frankfort	KY	40601
O.M. and Mary Leigh Patrick	515 Leawood Drive	Frankfort	KY	40601
Wren H. and Volinda M. Walters Living Trust	515 Reed Drive	Frankfort	KY	40601
Thelma E. Mitchell Estate c/o Phillip Tracy, Jr., Executor	1046 Briarwood Drive	Lawrenceburg	KY	40342
Michael D. and Linda S. Hancock	278 River Valley Road	Frankfort	KY	40601
Michael D. Hancock	270 River Valley Road	Frankfort	KY	40601
John Simpson	1525 Germany Road	Frankfort	KY	40601
Edwin B. Tutt, Jr	629 Clover Drive	Frankfort	KY	40601
William J. Niemy	9271 Acres Way	Lake Park	FL	33403
Jim H. Plemmons	360 Watts Ferry Road	Frankfort	KY	40601
Old Taylor Partners, LLC	40 Burton Hills Blvd., Ste. 320	Nashville	TN	37215
William Long	3600 McCracken Pike	Frankfort	KY	40601
Gary and Linda Tate	3720 McCracken Pike	Frankfort	KY	40601
Kentucky Utilities	1 Quality St	Lexington	KY	40507
Gary Wilkerson	Route 1	Midway	KY	40347
The Clyde E. Buckley Wildlife Sanctuary c/o Community Trust and Investment Company	100 East Vine Street, Ste. 700	Lexington	KY	40507